JAN 23 1929

QST

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PUBLISHED SINCE 1915 BY THE AMERICAN RADIO RELAY LEAGUE INC.

New Short-Wave Receivers for 1929

Full Details IN THIS ISSUE

NOV. 1928

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Secondary D.C. Resistance	9300 Ohms	11,000 Ohms
Amplification Ratio	1:2	1:3.5
Permissible Primary Current	5 MA.	5 MA

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QST

The Official Organ of the A·R·R·L

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The American Radio Relay League, Inc., is a non-commercial association of radio amateurs, bonded for the promotion of interest in amateur radio communication and experimentation, for the relaying of messages by radio, for the advancement of the radio art and of the public welfare, for the representation of the radio amateur in legislative matters, and for the maintenance of fraternalism and a high standard of conduct.

It is an incorporated association without capital stock, chartered under the laws of Connecticut. Its affairs are governed by a Board of Directors, elected every two years by the general membership. The officers are elected or appointed by the Directors. The League is non-commercial and no one commercially engaged in the manufacture, sale or rental of radio apparatus is eligible to membership on its board.

"Of, by and for the amateur", it numbers within its ranks practically every worth-while amateur in the world and has a history of glorious achievement as the standard-bearer in amateur affairs.

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EDITORIALS

TIMES of community disaster, as from hurricane or flood, offer the radio amateur his great opportunity for service. He has never been found wanting. In many years no community in distress in this country has been without valiant assistance from amateur radio. The recent West Indian hurricane was no exception.

When this storm hit Porto Rico and the Virgin Islands, ham radio was on the job. The normal communication of these people with the mainland is by navy radio but the navy stations went out with the storm. Amateur radio to the fore! The San Juan naval station got on the air with improvised apparatus, operating in the amateur band for quick contact, and got it in a hurry—amateurs promptly tied them up with the Navy Department at Washington. The naval station at St Thomas, in the Virgin Islands, similarly was wrecked by the hurricane, but one of the operators there was an amateur and promptly got on the air with his ham station, np4AAN (now K4AAN), and in short order, through the assistance of numerous amateurs, was in direct communication with NAA. Not only that, but this humble amateur station then proceeded to change to a naval frequency and became NBB, succeeding to the call as well as the duties of the wrecked naval station. Up to a few short months ago amateur operation was not permitted in the Virgin Islands. Here was ample demonstration of its worth, with the Governor of the Islands in direct communication with official Washington at a time when it was most important. The amateurs concerned in these activities have received letters of thanks and public commendation by the Navy Department.

With ample warning, this hurricane found the amateurs of unhappy Florida mobilized to receive it. Most of the amateur stations of Florida were on the job, with spare batteries laid by and everything set for a long vigil. Innumerable stations share the honors of that black week. Many of them kept their communities informed on the progress of the hurricane and supplied them with news when wires went out. Much public message traffic was handled. Other amateur stations, in the region where the storm struck, had more serious duties, for they were the only links between cities filled with death and suffering and a nation waiting to help. Of these stations, 4AFC at Palm Beach was the star performer, and it discharged its duties in full keeping with the traditions of amateur radio and in a way to make the old heart well up in admiration. The station was operated by Ralph Hollis, and Forrest Dana of 4AGR. Dana is a civil engineer, Hollis a driver for the Fire Department, where his station was located. When there were definite signs that the hurricane would hit Palm Beach, these two men went out at 1:30 a.m., hunted up a dealer and bought a set of "B" batteries for emergency power and borrowed some storage batteries, and prepared themselves for the worst. It came. The antenna went, and it seemed the building would too. Risky as it was to go outside, they had to abandon their station; but during a short lull they returned and retrived the apparatus, found another location at the other end of the building, and under the most adverse and dangerous conditions managed to get an antenna up and signals on the air. From Monday to Thursday of that eventful week that station was continuously on the air. It did a noble job exchanging vital messages with many amateur stations and reporting the scene at Palm Beach to the outside world. The War Department net control station, WVA at Washington, was on the air looking for Florida stations, and with the assistance of other amateurs was hooked up with 4AFC. By this means the first reports to the American Red Cross were made, starting the relief machinery of that organization, and by the same channel the word was conveyed that brought Army blankets, cots and supplies for the stricken area from Atlanta.

The Red cross and the town of Palm Beach have expressed their thanks for the amateur service. The Army, as the branch of our government directly concerned with relief measures in emergencies (the basic idea of the Army-Amateur Affiliation) issued a public statement from which the following is quoted:

"Messrs. Hollis and Dana realized the urgent need for outside communication and established it, clinging to their self-imposed task with a purposeful tenacity worth of highest praise. For three days these two men stayed at their instruments, disregarding personal safety and interests until the regular channels of electrical communication with the outside world were restored. Mr. Dana lost his home, his automobile and all personal effects in the storm. Both men ate what food where and when it could be received and neither slept in a bed during their self-appointed vigil."

And General Gibbs, Chief Signal Officer of the Army, sent them the following message via WVA at the conclusion of the job:

"It has indeed been a pleasure for the Army radio station WVA to work a schedule with your station during the recent emergency in Florida and it is with regret that we discontinue this schedule. Regulations now control'ing the operation of the War Department radio station WVA prevent us from competing with commercial companies. Reports from Western Union Telegraph Company and subsequent messages received here show that the Western Union Telegraph Company is now able to handle your traffic. This being the case the Army must sign off and say good-bye to you two men. You are to be commended for your untiring effort and loyal devotion to duty which you have so well expressed during the last three days and we shall always remember this worthy duty well performed."

This West Indian hurricane is "one more for the book". It has brought the amateur very forcibly to the attention of the public, resulting in newspaper editorials of praise and an increased recognition of amateur value by many agencies of importance in our national existence. In such tragedies of American life as the Vermont and Mississippi River floods, the two Florida hurricanes, the Illinois tornado, the Santa Barbara earthquake, amateur radio has fully demonstrated that it is of the highest utilitarian service to the community and the country at large. We amateurs are now expected to render this service when other agencies fail. A.R.R.L. Headquarters knows that A.R.R.L. members will regard this as a sacred trust; that, without rules and formal organization, every man can be counted upon to get on the air when his neighborhood needs him and do a clean-cut job in the good old A.R.R.L. way—to the continued glory of amateur radio!

K. B. W.

Standard Frequency Transmissions from W9XL

STATION W9XL is a special station comprising one of three portions of the "Gold Medal Station," WCCO-W9XL-W9WI at Anoka, Minnesota. WCCO is operated as a broadcast station, W9XL purely as a standard frequency station and W9WI as a general amateur station. The three transmitters have independent equipment and antennas but a common power supply. Through arrangements made by K. V. R. Lansingh of the Official Frequency Station Committee of the Experimenters' Section, A.R.R.L., W9XL is operated on schedules regularly announced in *QST*. The work of operating the station is done without charge by Assistant Chief Engineer Hugh S. McCartney, with the assistance of Lyall K. Smith and Ivan H. Anderson also of the staff of WCCO.

While no guarantee of accuracy is made on a gratis service, it is the aim of the staff to maintain an accuracy of 1/10 of 1%, which is materially better than can be held by most frequency meters. The frequencies are measured by means of standards which have been especially standardized for this purpose by the Bureau of Standards.

A small percentage of tone modulation is employed so that the signal is distinctive and more quickly recognizable.

The fact that this service has been rendered in the past is no guarantee of its continuation indefinitely in the future. It depends upon whether the response received seems to warrant the amount of work and expense involved in maintaining this service to all amateurs. If you take advantage of this service, please acknowledge that you are doing so by notifying the Experimenters' Section, A.R.R.L., 1711 Park Street, Hartford, Conn. You may use ordinary stationery or special blanks may be obtained from the above address. A number of these blanks has been gathered and as the number grows we will gradually gain a unique and accurate record of transmission phenomena possible with no other station.

Schedules for November

Schedule "A" Central Standard Time (PM)	Frequency in kc.	Schedule "B" Central Standard Time (PM)	Frequency in kc.
8:00	7,300	3:00	30,000
8:12	7,225	3:12	29,000
8:24	7,150	3:24	28,000
8:36	7,075	3:36	14,400
8:48	7,000	3:48	14,300
9:00	4,000	4:00	14,200
9:12	3,750	4:12	14,100
9:24	3,500	4:24	14,000

Division of time

4 minutes—QST QST QST de W9XL W9XL W9XL
3 Minutes—Series of letter "d" with the dash about 5 seconds long and broken every half minute for station call letters.
1 minute —Freq ———— kc.
4 minutes—Time allowed to change to next frequency.

Dates of transmission

November	Schedule	December	Schedule
2nd	"A"	9th	"B"
11th	"B"	14th	"A"
16th	"A"	28th	"A"
30th	"A"		

All O.F.S. should use these transmissions to keep their frequency meter calibrations within the required limits of accuracy. It will be appreciated if you will send us a report on your reception of these signals.

—*H. P. W.*

High-Frequency Receivers for the Coming Year

Incorporating Thoroughly Practical and Satisfying Selectivity, Open Scales, and a New Ease in Handling

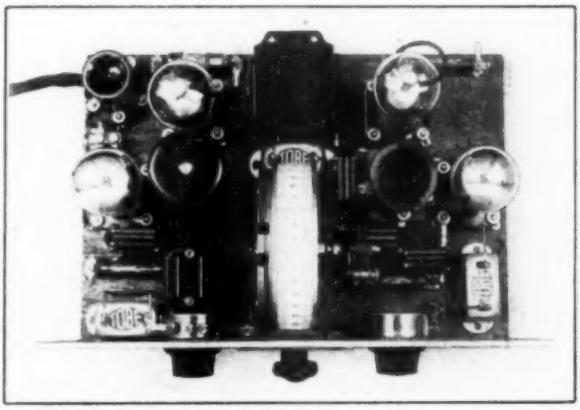
By Ross A. Hull*

The A.R.R.L. Technical Development Program has now turned its attention to the question of receivers, and in this article Mr. Hull reports the very gratifying results which have been attained. Practical selectivity for 1929 has been secured; it is within the reach of every amateur. In tests of the 4-tube model described in this article, in the 7000-kc. band in the early evening hours, when on this coast the activity is great and the interference most intense, we have not found a case where we were willing to admit without reluctance that the signals were exactly "on top of each other". Its sensitivity has been equally pleasing, practically every American signal heard has been of loud speaker strength; most Australasian signals twenty feet from the phones and reduced to comfortable head-phone volume only by disconnecting antenna and setting volume-control at minimum. It is, we honestly believe, a real "bear-cat".

Mr. Hull has now covered the fields of transmitting, receiving and measuring. His articles enable every amateur to prepare for 1929 with minimum effort. Further developments will be reported soon.

—Editor

THE short-wave receiver has always been a subject on which two or more amateurs could argue for indefinite periods. Indeed the subject has such potentialities for discussion that the individual amateur, unaided, can readily stir up a debate within himself and cogitate into the night upon the details of his next outfit. The receiver, unlike the other more inert apparatus, being so constantly under the demand of a knob-twisting operator, is a splendid comfort, if it works well, or a great curse if it operates poorly. There are few half-measures. It is, perhaps, for this reason that the amateur, as a general rule, is so fixed in his ideas on the subject and so willing to argue until the bitter end in the interests of the throttle control or left-hand tuning that he may have been using in his successful outfit. It is, furthermore, for this same reason that we do not expect any of the three receivers, to be described, to excite the complete approval of any amateur. We do trust, however, that they will be accepted as examples supplied (as in previous apparatus evolved by the Technical Development Program) not to represent the acme of design perfection but merely to illustrate the practical application of features found desirable to meet the requirements of the coming year. It is thought that a study of the features of each of the receivers may facilitate the evolution of an outfit with a combination of desirabilities calculated by the individual to represent his idea of the ideal.



THE FOUR-TUBE RECEIVER

Being provided with plug-in variable tuning condensers to give full-scale coverage on any band and a screen-grid audio amplifier highly peaked at 1000 cycles to improve selectivity, the receiver is particularly suited for the requirements of next year. To the right of the drum dial the screen-grid antenna coupling tube, the detector and the plug-in coil can be seen grouped near the midget tuning condenser. To the left of the drum dial the two audio tubes and the 1,000-cycle tuned coupling circuit are grouped in somewhat similar fashion. The Ford ignition-coil secondary used in this coupling circuit is enclosed in a tube shield. Immediately in front of it is the bank of fixed condensers used to tune it to the required audio frequency.

It is very evident, we believe, that the

*Associate Technical Editor, *QST*. In charge A.R.R.L. Technical Development Program.

ideals and requirements of the present and those of the future are to differ widely in many respects. It will be well, perhaps, to make a brief review of them.

For the last few years the successful receiver has been one in which an oscillating detector fed an audio-frequency amplifier of one or two tubes. For the tuner some simple arrangement of plug-in coils has

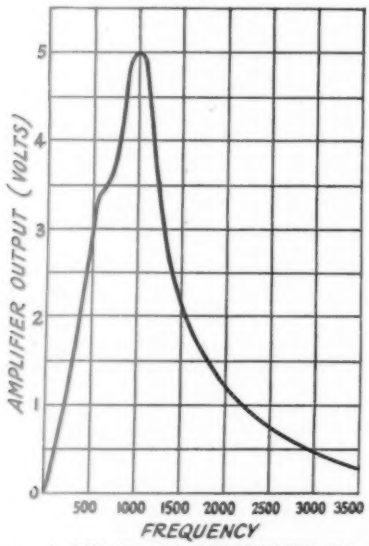


FIG. 1. A CURVE OF FREQUENCY VS. OUTPUT VOLTS TAKEN WITH THE THREE-TUBE RECEIVER

The selectivity provided by a relatively broad peak of this type is all that is considered practical under present conditions. With the amplifiers described, much more pronounced peaks and greater selectivity can be obtained at will by the use of a lower-resistance tuned audio circuit.

been required, together with a tuning condenser of sufficiently low capacity to enable the various bands to be fairly well spread across the dial. Since the edges of the bands have been harmonically related, a tuning condenser which gave full scale coverage for any one band has been satisfactory for all others. No particular demands have been made on the circuits of the detector tube except that they be so arranged as to avoid "hand-capacity" effects and permit the adjustment of regeneration without the accompaniment of too serious a variation of tuning. Though some slight interest has been shown in the use of audio-frequency amplifiers "peaked" at some audio frequency, the amplifier usually considered most successful has been that which provided the greatest gain. Since the advent of the UX-222, radio-frequency amplification has been exploited to some extent, but in most of the equipment described so far the constructional complications and the addition of a second major tuning control have debarred the scheme from general adoption. Further, it has not been evident in practice that radio frequency amplification provides perceptible improvement in the range of the short-wave telegraph receiver, or in the ratio of signal to "background" noises.

THE NEW REQUIREMENTS

The reduction in the widths of our future bands and the addition of most foreign stations to them, make it clear at once that selectivity is likely to be one of the most important requirements of next year's receivers. It is certain that there will be many stations within a few hundred cycles of each other which, unseparable with present equipment, must be individually readable with the new receivers. Then, the odd widths of our various bands will introduce another requirement—that of adjusting the range of the tuning unit so that each band is spread across a wide segment of the dial. As has already been explained in the October *QST*, an ordinary variable condenser which tunes the new 3,500-kc. band across most of its dial would be unsuited for work on the higher-frequency bands since their entire territory would be cramped into some impossibly small slice of the condenser range. With open tuning scales will come another desirability—something approaching permanence of calibration. It will be a decided disadvantage if the tuning circuit, fitted with a suitably small variable capacity to place the limits of the band between 15 and 85 degrees of the dial, is influenced by the antenna to the extent common in most existing receivers, for it would then probably be necessary to wind and adjust the coils for the particular antenna available and amend them for use with any antenna of other dimensions. In present-day receivers where relatively large tuning capacities are used and in which the bands are rarely spread across the entire dial, the importance of this consideration has not been evident. And while we are remodelling our receivers we might well add to the purely "1929" requirements the existing (but rarely attained) desirabilities of freedom from microphonic and tuning noises, and smooth regeneration control without "dead areas" or appreciable influence on tuning. Then, along at the tail end we will mention the obvious requirement that sufficient sensitivity be maintained to enable the receiver to respond audibly to all signals which are not completely buried under the "background" of static and miscellaneous electrical "noises".

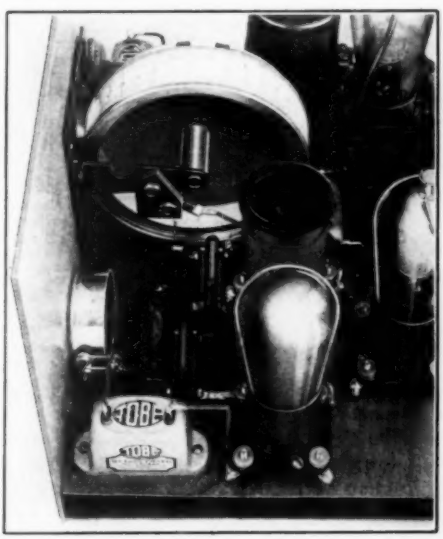
In examining the practicalities involved in the attainment of these desirabilities in the 1929 receiver it becomes clear at once that the prime requisite, high selectivity, is a concern of the audio-frequency amplifier. Unlike the broadcast receiver, the oscillating receiver has the selectivity of its radio-

frequency end set by the very heterodyne principle used in its operation. If it is oscillating at a frequency 500 cycles different from that of a c.w. transmitter within its range, a 500-cycle beat frequency will appear in the plate circuit of the detector; and no practicable amount of radio-frequency amplification would eliminate that signal or any undesired signal if its frequency differed from that of the oscillating receiver by a frequency within the limits of audibility. If, however, the audio frequency amplifier was so arranged or so equipped as to make it pass a band of frequencies only two hundred cycles wide at say 1,000 cycles, then all transmitters whose frequency differed from that of the receiver by more than 1,100 or less than 900 cycles would fail to produce signals in the output of the receiver. In other words, just so long as a group of transmitters had their frequencies separated by 200 or more cycles they could be tuned in individually at the receiver to give a beat note within the pass band of the audio amplifier, and interference between them would not result.

There are few difficulties in equipping the audio-frequency end of the receiver to provide such a condition, as has been shown by Bourne in his treatment of Acoustic Wave Filters[1], and, as far as the field of reception is concerned, a complete solution to the problem of selectivity is available. In the specific field of amateur communication, however, the solution is not nearly as complete. If the majority of amateur transmitters were 200 or more cycles apart, if their frequencies were constant and if they did not flutter, wobble and creep across territory measurable only in thousands of cycles, we could sit back and laugh at our problem. But such is not the case. Experiment has indicated that a receiver fitted with a band-pass filter to give it the selectivity available would cause a large percentage of present signals to be unreadable unless they were "followed" continuously with a precise vernier tuning control. An almost equal number of signals probably would be entirely unreadable on account of rapid frequency wobbles and keying chirps which would, in accordance with such frequency changes, intermittently wipe the signal out of audibility. Careful observation and estimation has caused us to decide that even with the vast improvement in signal character expected in 1929 it will not be practical to carry the selectivity of the receiver to the extremes possible. Rather will it be desirable, it seems to us, to limit the selectivity to something of the order of that provided by the four- or three-tube receivers described, an approximate idea of which can be obtained from the response curve given in Figure 1. In such an amplifier the necessary constructional work and expense are far below those necessary for the acoustic or electric band-pass filters necessary to obtain the highest possible degree of selectivity, yet the simple amplifier provided will contribute greatly to the solution of the interference problem of the immediate future. It will be particularly suited also for operation with the highly selective band-pass arrangements which undoubtedly are to be used generally in the intermediate future.

"PEAKED" AMPLIFIERS

The method used to obtain the degree of selectivity considered desirable is none other than the ancient "peaked" or tuned amplifier which has been used for so long in some commercial and amateur stations. The scheme has been made much more effective and more useful, however, by utilizing those characteristics of the screen-grid tube which have so limited its use as an audio frequency amplifier for the broadcast receiver. Unlike the three-electrode tube the voltage amplification of the screen-grid tube is dependent almost entirely upon the load impedance, and whereas there is an optimum practical value of load impedance for maximum voltage amplifica-



A CLOSE-UP SHOWING THE MOUNTING FOR THE PLUG-IN TUNING CONDENSERS

The drum dial used is seen to be particularly suited for the mounting of the plug-in condensers—even if it does dwarf them in size. Two G. R. sockets mounted on a piece of hard rubber are spaced so as to receive the two pins on the condensers. One of the sockets serves to hold the assembly to the frame of the dial and at the same time makes the ground connection from the condenser to the dial and the panel.

1. "Acoustic Wave Filters and Audio Frequency Selectivity," by R. B. Bourne, *QST*, August, 1928.

FIG. 2. THE WIRING OF THE FOUR-TUBE RECEIVER

The under surface of the wooden base-board is covered with thin sheet copper to which all the "ground" leads are run. This construction is preferable to placing the copper on the upper surface where it introduces difficulties in the insulation of components from it.

C —1-μfd. by-pass condensers.
C1—Plug-in midget tuning condensers.
C2—4000-μμfd. fixed condenser. (see comment below).
C3—100-μμfd. grid condenser.
C4—2,000-μμfd. by-pass condenser.
C5—6000-μμfd. audio grid condenser.
C6—.01-μfd. audio tuning condenser (experiment necessary)
R —10,000-ohm grid.eak-type resistor.
R1—10-ohm Yaxley fixed filament resistor.
R2—5-ohm Yaxley fixed filament resistor.
R3—6 megohm gridleak.
R4—50,000-ohm Frost variable resistor.
R5—200,000-ohm Frost variable resistor for volume control.
R6—8-megohm gridleak.
R7—Filament ballast resistor for .75 amperes.
L1, L2—Tuning inductance and tickler wound on plug-in coil form.
L3—The secondary winding of a Ford ignition coil—core and primary removed.
R.F.C.—Receiver-type short-wave choke.

Some difficulty may be had in adjusting the tickler turns due to "dead-spots". It is suggested that the capacity of C2 be varied if any such trouble is experienced. The use of a filament rheostat is made unnecessary by the incorporation of a ballast resistor. It is, of course, possible to use a fixed resistor or a rheostat in its place. Though a number of "grounds" are indicated on the diagram it should not be thought that these are "grounds" of the water-pipe variety. They merely indicate connections to the panel or copper sub-base. Ordinarily, no external ground is used.

tion with the three-electrode tube, the amplification available with the screen-grid tube will increase steadily as the load impedance is increased to the limits obtainable in practice. The tuned circuit at its resonant frequency becomes an impedance of a high order, permitting the tube, at this frequency, to provide a degree of amplification which could certainly never be approached with any tube of the three-electrode type. Hence, a tuned output circuit, in the plate circuit of a UX-222 resonating at, say, 1000 cycles, at once gives an effective and highly peaked amplifier. Reduced to a thoroughly practical form by the use of the secondary of one of Ford's now antiquated ignition coils as an inductance, and the elimination of possible screening (with some admitted sacrifice in performance) the arrangement is as shown in Figure 2.

In practice the amplifier operates splendidly, proving a high degree of amplification when the signal is tuned to the resonant frequency of the Ford coil-condenser combination (as can be seen from Figure 1) and dropping other beat notes of appreciably different frequencies to very low values of audibility. This selection of signals of one particular frequency makes it difficult and sometimes impossible to read stations with chirpy or wobbly signals but in the case of the rapidly increasing army of steady clean-cut signals the improvement in readability through interference is at once obvious.

THE TUNER PROBLEM

To continue this examination of the requirements into the field of tuning systems we find that many solutions are available for the problem of providing a different order of tuning-capacity variation for the various band widths. The method which we have found most practical so far is that built into the four-tube receiver shown. It consists merely in the provision for plug-in midget condensers, of which there are three, each adjusted by the removal of plates to give the capacity range found necessary for the bands on which they are to be used. The condensers used in this particular receiver are Pilot midgets, chosen on account of their satisfactory design and their particular adaptability for the process of plate removing. In order to provide the plug-in connections, G. R. pins are fitted in the manner shown in the photograph of the coils and condensers. For the rotor connection a complete G. R. pin replaces the short machine screw holding the spring contact to the end plate. For the stator connection a G.R. pin, the threaded portion of which has been sawed off, is sweated to the head of one of the machine screws supporting the stator assembly. To provide a mounting for the sockets into which the condenser is plugged, and to provide a readily accessible collar and set screw for the condenser shaft, a National drum dial was chosen. The exact arrangement of the hard rubber socket mounting on the frame of the dial can be seen in the photograph.

It should be pointed out, perhaps, that this is just one possible arrangement. It is to be expected that the ever resourceful amateur will soon evolve an alternative rig more suited to his own ideas and the apparatus at his disposal. The expected difficulties of movement of the condenser in its mountings and destruction of the calibration upon removal and replacement of the condensers have not been found in practice. With accurate spacing of the sockets, the G. R. pins hold the condenser with splendid rigidity, while calibration is restored, when the condenser is replaced, by the simple process of adjusting the condenser to its maximum setting (by pressing the fingers on the edges of the rotor and stator plates) and inserting it in the collar of the dial shaft with the dial set at 100 degrees. The six-plate condenser in its original form has been found satisfactory for the 1,750- and 3,500-kc. bands. For the 7,000-kc. band, two rotor and one stator plates are used, while for the 14,000- and 28,000 kc. bands a single rotor and stator have been found to give satisfactory coverage.

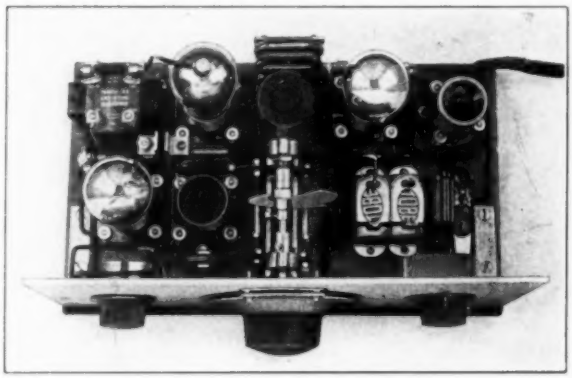
In the three-tube receiver the sliding rotor condenser, which was described on page 13 of the October *QST*, is employed to illustrate an alternative scheme. It has, in practice, also been found to be a thoroughly practical solution for the problem. On account of the existence of a description of the construction of the condenser and the method of adjusting it, no further details should be necessary.

A THIRD METHOD

In the two-tube receiver yet another alternative solution is incorporated for the purpose of illustration. In this case the usual tuning condenser of about 50 μμfds. is used as the tuning control with a 23-plate Pilot midget condenser connected in series with it and used as an adjustable series capacity to reduce to predetermined values the capacity range of the tuning condenser proper. With the midget set at its minimum capacity the range of the tuning condenser is reduced to the point where its maximum capacity is equal to the extremely small value of the two condensers in series (possible about 5 μμfds.). As the capacity of the adjustable midget is increased the capacity range of the tuning condenser is increased to the point where the midget is at its maximum. At this point the capacity range of the main condenser will be such that the resultant maximum capacity is of the order of 33 μμfds.

In operation the arrangement is beautifully flexible since the tuning range is continuously and readily adjustable to any of the values required for the work.

It is, perhaps, unnecessary to mention that this particular method is particularly useful in cases where it is not desired to rebuild an existing receiver entirely, the simple process of fitting a midget condenser being all that is necessary to adapt a receiver suited for the present bands for operation in the coming year. The



A PLAN VIEW OF THE THREE-TUBE SET

The use of a sliding rotor on the tuning condenser for tuning range adjustment and a peaked amplifier similar to that of the four-tube set make this receiver a practical one for next year's operation. The "tube-base" coil and detector tube can be seen to the left of the variable condenser. Immediately behind the condenser is the Ford coil secondary of the peaked amplifier. The tuning condensers across it are mounted on brass strips immediately behind it.

one slight disadvantage of the scheme is that the tuning curve of the condenser, be it straight-line-frequency or capacity, is disturbed. The straight-line-frequency condenser in the receiver illustrated, for instance, gives a curve somewhat similar to that of a straight-line-capacity condenser when the smaller values of series condenser are used. With the larger values of series condenser the curve departs only slightly from that of the tuning condenser alone.

In conjunction with these variable capacity systems, plug-in coils of the usual type are employed. In the four-tube receiver Silver-Marshall coil forms are used. On account of the small values of tuning condenser across the coils it will be found that their values differ somewhat from those with which we have become familiar. Also, on account of the small frequency range to be covered, and the desirability of placing this range between 15 and 85 degrees on the dial, it will be found that the number of turns is quite critical. It is for this reason that ready-wound coils are not likely to be suitable for the work without the addi-

tion of turns. In order to facilitate the work of adjusting the coils it has been found worth-while first to wind them so that the condenser at 85 degrees tunes them slightly below the lowest frequency required for the particular band. Final adjustment is then made by spacing one or two of the end turns until the edge of the band is brought to about the 85-degree setting of the condenser. This scheme is preferable to that of removing turns since it is often found that a fraction of a turn only could be removed from the coil without spoiling its coverage.

One splendid advantage of all three tuning systems used in these receivers is that while they give "full coverage" for the amateur bands they are still useful for reception in any special bands and on any particular frequencies between them. If it is necessary to receive some station half way between the 14,000- and 7,000-kc. bands, for instance, the midget condenser normally used for 3,500-kc. work, in the four-tube receiver, would be plugged into place and used with the 14,000-kc. coil. In the three-tube outfit the rotor plate would be set at the position of maximum capacity to obtain a similar result, while in the two-tube affair the midget series condenser would merely be placed at the setting normally used for work on one of the two lower-frequency bands.

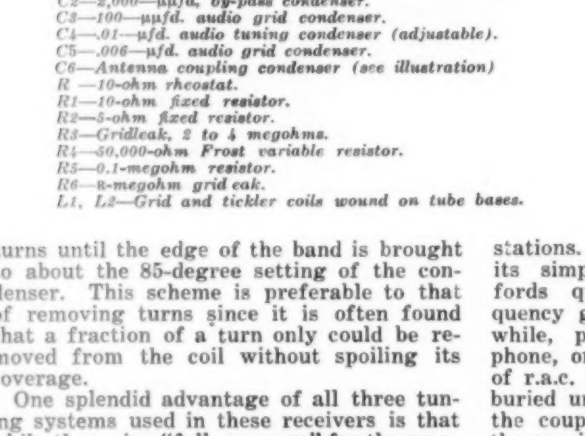


FIG. 3. SHOWING HOW THE THREE-TUBE RECEIVER IS WIRED

C —1—μfd. by-pass condensers.
C1—"Sliding-rotor" type variable condenser (see text)
C2—2,000—μμfd. by-pass condenser.
C3—100—μμfd. audio grid condenser.
C4—.01—μfd. audio tuning condenser (adjustable).
C5—.006—μfd. audio grid condenser.
C6—Antenna coupling condenser (see illustration)
R —10-ohm rheostat.
R1—10-ohm fixed resistor.
R2—5-ohm fixed resistor.
R3—Gridleak, 2 to 4 megohms.
R4—50,000-ohm Frost variable resistor.
R5—0.1-megohm resistor.
R6—8-megohm grid eak.
L1, L2—Grid and tickler coils wound on tube bases.

CONSTRUCTIONAL DETAILS

And now let us proceed to a description of each receiver in turn with the idea of detailing the features which have been incorporated to fulfill some of the minor requirements mentioned earlier in this article.

In the four-tube outfit, as can be seen in Figure 2, a UX-222 is used as a coupling tube between the antenna and the detector. In order to avoid the necessity for a second tuning control the tube is arranged to operate from the drop across a resistor of 10,000 ohms connected between the antenna and the filament circuit of the receiver. A radio-frequency choke, such as that built for the purpose by National, can be used in place of this resistor if desired. To drop the filament voltage to the required 3.3 volts for both the UX-222 and that used as audio-frequency amplifier, 5- and 10-ohm Yaxley resistors are connected in series. A suitable negative grid bias is then obtained in each case by connecting the grid return to the junction between the two resistors. The coupling tube in this particular receiver is found to justify its existence completely. In the first place it eliminates the influence of the antenna over the tuning of the receiver, so permitting the receiver to be calibrated for the approximate estimation of frequency and for convenience in locating known stations. In addition to this, even with its simple untuned grid circuit, it affords quite an appreciable radio frequency gain which undoubtedly is worthwhile, particularly in the reception of phone, or in the reception, non-oscillating, of r.a.c. signals which ordinarily would be buried under heavier d.c. signals. Further, the coupling tube reduces radiation from the receiver to a practical minimum.

The output of the UX-222 is connected directly to the grid tuning circuit of the detector, which is so provided with a fixed condenser in series with the tuning condenser, as to isolate the coil from the filament circuit in order that it may carry the plate supply to the UX-222. For the same reason the detector grid leak is not connected across the grid condenser but is carried directly to the positive filament lead. The detector circuit is otherwise arranged in quite the normal fashion, resistance control of regeneration being provided on account of the manner in which it operates without influencing the tuning to any appreciable degree. In connection with this arrangement it might be pointed out that the usual half-scale setting of a 50,000-ohm variable resistor results in quite a drastic drop in voltage. With the detector operated from the 22½-volt battery tap, the ac-

tual voltage reaching the detector under such conditions is usually of the order of 8-10 volts. If the detector is to be operated at its rated voltage it is obvious that the 45-volt battery lead be used and the ticklers wound accordingly to give oscillation at the mid-point of the variable resistor range.

THE AUDIO SYSTEM

The output of the detector is fed to the grid circuit of the UX-222 audio amplifier through an audio transformer of the usual type. Although a broadcast-receiver transformer with a particularly flat frequency characteristic is not necessary, the use of an Amertran or equally high-grade transformer will be found justified on account of the excellent gain provided by it. This does not mean, however, that the transformer used in any existing receiver would not be equally effective in this one.

In the plate circuit of the UX-222 audio tube is the tuned circuit, resonating at 1,000 cycles or some other convenient frequency, which is responsible for the peaked amplification and the improved selectivity of the receiver. The degree of amplification to be obtained with this tube and the sharpness of the peak are matters governed almost entirely by the impedance provided by the tuned plate circuit at the resonant frequency. The value of this impedance, in turn, is limited by the resistance of the circuit To obtain the greatest peak and amplification, therefore, it would be necessary to use the lowest-loss inductance and condenser possible. Experiment with various forms of inductance (the characteristics of the capacity being somewhat set by the types of condensers available) has shown that an inductance of reasonably low resistance can well provide a peak much in excess of that considered desirable for practical purposes in the immediate future. The characteristic shown in Figure 1 is that obtained with a Ford coil secondary as the inductance, used for the definite purpose of broadening the peak and because of its general availability to the amateurs of any country. Most of the coils tried tuned to about 1,000 cycles by the connection of about .01 μfds. across them. In the four-tube receiver the bank of Sangamo condensers comprising this tuning capacity is mounted on two threaded rods to facilitate experiment with capacities of different values. The Ford coil is mounted by inserting a wooden dowel in the space left by the removal of the core and primary winding, and by attaching this dowel to the base-board with a wood-screw inserted through the base. In this receiver an aluminum tube shield is inverted over the coil for the purpose of shielding. Its use, however, was not found to be essential.

Should it be desired to produce a sharper peak than that provided by the Ford coil it would be necessary merely to use an inductance of lower resistance. One inductance used in our work (which incidentally gave a peak far too sharp to be practicable for general reception) consisted of

ANOTHER VIEW OF THE THREE-TUBE RECEIVER

The simple and conventional practice of screwing all apparatus to the base and connecting everything with bus bar has been adhered to.

3,000 turns of 30 gauge s.s.c. wire "scramble"—wound in five ¾"—square slots turned in a wooden former 2" outside

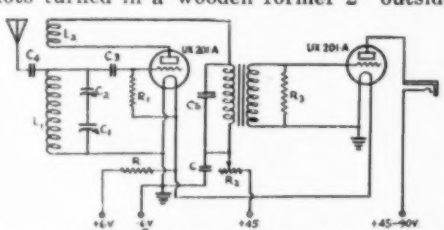


FIG. 4. THE SIMPLE WIRING OF THE TWO-TUBE SET

C —1-μfd. by-pass condenser.
C1—50-μμfd. tuning condenser.
C2—23-plate (approx. 100 μμfd.). Pilot midget.
C3—100-μμfd. grid condenser.
C4—Antenna coupling condenser—two ¾" square plates about 1/2" apart.
C5—2,000-μμfd. by-pass condenser.
R —Half-ampere ballast resistor.
R1—Gridleak, 2 to 4 megohms.
R2—50,000-ohm variable resistor.
R3—0.1-megohm resistor.
L1, L2—Coils similar to those used in three-tube set.

diameter. About .07 μfds. was found necessary to tune this to 1000 cyles. Ex-

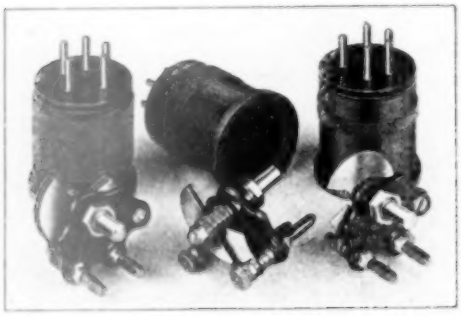
periment with other forms of inductance will be found of great interest and value.

The fourth tube of this receiver is a 201-A arranged in the normal fashion. This tube is not necessary to provide amplification additional to that already available, but is essential to provide a satisfactory output circuit since the phones could not be operated in the plate circuit of the UX-222. The enormous amplification provided by the two audio tubes makes the use of a volume control essential.

The UY-type socket and UY tube base to be seen at the extreme left rear corner of the base are used to make all battery connections. An ordinary battery cable is led into the tube base through a hole in one side and the leads soldered to the various pins. The arrangement has been found surprisingly convenient from every possible aspect, and never again will we be guilty of using a string of binding posts unnecessarily monopolizing a long strip of bakelite.

THE TWO-TUBE PHONE RECEIVER

The feature of adjustable tuning range is obtained in this set by the use of a midget condenser in series with the tuning condenser. The value of this method, as described in the text, is in the possibility of its use to convert an existing tuning system for 1929 use by the simple addition of a midget series condenser. The usual type of audio-frequency amplifier shown in this receiver will still be necessary in receivers to be used for phone reception.



COIL-CONDENSER COMBINATIONS FOR THREE BANDS

Differing from present day practice a separate tuning condenser is used with each inductance in the four-tube receiver to give full scale dial coverage for each band. The grid coils are wound with 20-guage d.s.c. wire on Silver-Marshall coil forms. As a rough guide it can be said that 6 turns are used for the 14,000-kc. band; 14 turns for the 7,000-kc. band; 31 turns for the 3,500-kc. band. The ticklers found suitable are of 30-guage d.s.c. wire, 5 turns being used for 14,000-kc., 7 turns for 7,000-kc. and 9 turns for 3,500-kc. It is almost certain that these figures will vary in individual receivers.

We hesitate to make any mention of the performance of these receivers on account of the many factors which influence it, and because of the possibility of arousing expectations which may be beyond fulfillment in individual cases. We do believe, however, that these four tubes are truly worth while and that the available sensitivity, selectivity and amplification are equal to any reasonable demands that could ever be made on them. In addition, we think that the receiver is particularly suited for the requirements of the future, having provision for tuning range adjustment which would adapt it to any desired frequency band, and having an amplifier which, with simple amendment, could be given any increased selectivity which may be made practicable by wide improvement in the emissions of amateur stations.

THE THREE-TUBE SET

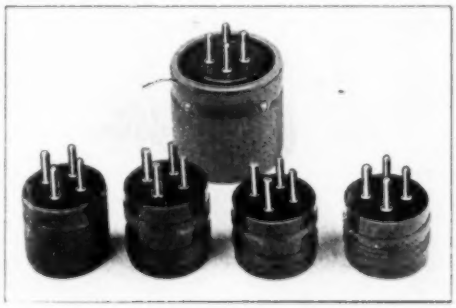
In the three-tube receiver, as can be seen in Figure 3, the antenna coupling tube has been eliminated and the usual capacity coupling scheme incorporated. This means the sacrifice of some sensitivity and an increase in the influence of the antenna over tuning calibration. The latter can, however, be reduced greatly by mounting the antenna coupling condenser as close as possible to the grid of the detector tube, and by reducing its capacity to the lowest value consistent with reasonable signal strength. The importance of the placement of this condenser is not, we believe, fully appreciated. Experiment has shown that the connection of the condenser in the antenna lead about six inches from the tube grid terminal can result in serious "hand-capacity" effects and a pronounced increase in the reaction of antenna changes on calibration.

The tuning circuit comprises the "sliding rotor" type of condenser mentioned previously, and "tube base" coils, while the audio amplifier consists of two tubes—a UX-222 and a UX-201-A arranged in the same circuit as that employed in the

four-tube set. The differences in the mechanical arrangement of the apparatus can be seen from the photographs.

FOR PHONE WORK

The two-tube receiver is presented chiefly to illustrate the use of adjustable series capacity to vary the capacity range of the tuning condenser. It is also intended to illustrate the single stage of flat-frequency-characteristic audio amplification which will still be desirable for the reception of amateur phone or short-wave broadcasting. The circuit is shown in Figure 4. The series midget condenser is controlled by the knob in the center of the panel, its positions for the various bands being determined by experiment and marked on the panel. The adjustment of this condenser will be found quite critical if it is desired to restore the calibration of the main tuning condenser when a change is made from one band to another, but this process is simplified very greatly by noting the dial readings for the commercial crystal-controlled stations at one edge of each band. Then, when the coil has been changed in moving from one band to another, it is merely necessary to set the tuning dial at the place where the "marker" station should appear and adjust the midget until it does. At this position the calibration will have been restored.



THE TUBE-BASE COILS USED IN THE THREE- AND TWO-TUBE RECEIVERS

Both grid coils and ticklers in these coils are wound with 24-guage d.s.c. wire. The numbers of turns used are as follows:

Band	Grid Turns	Tickler Turns
1,750 kc.	49	8
3,500 kc.	33.	7
7,000 kc.	15	6
14,000 kc.	6	3
28,000 kc.	3	3

No spacing is used between turns except in the grid coil for 28,000 kc. where the spacing is 1-8". As can be seen, the 1715-kc. coil is wound on a 2" diameter bakelite tube mounted on a tube base.

In all three receivers the panels were cut from ⅛" thick aluminum sheet. A pleasing finish was obtained by stripping the surface in a strong solution of washing soda and brushing it with a very thin coat of Duco clear lacquer.

In the construction of these three receivers no attempt was made to break away from the conventional method of screwing all the gadgets on a base and connecting them together, for we have the idea that there are very few departures from this standard amateur practice which warrant the complications involved by them. In fact, in all the work a definite effort was made to avoid any departure from the simple methods of the present day unless they possessed a definite practical value. We have had at our disposal scores of unusual circuits and arrangements, the merit of which was in their novelty. They were unused, however, because it is our opinion that the practicality of any scheme, in amateur radio, is at once questionable if it involves a sacrifice of simplicity.

Strays

One of the snootiest methods of mounting the League Auto Emblem we've run across is that of cementing the emblem to the inside of the wind-shield or rear window. The scheme is to remove the eyelets from the emblem, smearing it evenly with DuPont or some other good glass cement and, when the cement has become tacky, press it firmly to the cleaned glass surface. Considerations of visibility make it desirable that the emblem be located on the passenger side of the wind-shield at the lower corner though a position at the lower center of the shield also might be practical. The genius behind the scheme is Meserve of 1FL.

August McCollom, 9BQW-9HS, though blind, is an ardent and successful amateur. Since 1925 he has been on the air, during the summer at his home station 9BQW at Dodge City Kansas and during the remainder of the year from 9HS at the State School for the Blind at Kansas City, Kansas. A CX-310 supplied from a storage battery-driven 400-volt dynamotor is used at the latter station, while at 9QW an 852 does the oscillating. R7 signals have been put into Australia with it. McCollom is able to copy signals with a typewriter but, being unable to read the typing, all traffic is handled in Braille. In this manner he has been able to QSR as many as forty-five messages in a week. 'Taking it all round there is nothing unusual about my amateur activities', says McCollom. 'I build my sets and blow my tubes just as you fellows do.'

sj5BX

A True "Now-It-Can-Be-Told" Story that Unravels One of the Recent Mysteries of Amateur Radio

By Clair Foster*

HERE, you fellers who were so curious about sj5BX, the mystery station of last winter, here's your dope. His feet are now back on the soil of U.S.A. and it's safe to tell it. He had literally to shoot his way out; but he's out.

In November, 1927, I received a long letter with a Central American stamp from a chap named Haskell Watson. That's his real name. He was on an expedition. The letter was accompanied by photos and sketches depicting his location at the bottom of an extinct volcano. This old crater was narrow in both directions and the walls in most places were sheer 3000 feet. The letter contained also a list of the radio parts he had on hand. He had built one short-wave transmitter; but he hadn't been able to work anybody and had about come to the conclusion that he had been trying to transmit out of the bottom of a well 3000 feet deep and that it just couldn't be done.

He had other troubles, believe me. He was in a brigand-infested district. It was cold then up on the mountains and some of the brigands used to stick around his camp where it was warmer. He had reason to believe that some of his own helpers belonged to the gang. A guy came in on him one day while he was building his transmitter, and surmised that it had something to do with this radio stuff that the natives had been hearing about. This didn't look so good to a gentleman who didn't desire his whereabouts to be broadcast, so he ordered Haskell to smash it up. Haskell finally convinced him that he knew nothing about radio, that this was a scheme he was experimenting with for assaying minerals. This placated the old boy; but thereafter Haskell kept a sharper watch through the telescope he had trained on the only entrance to the crater. There was only one way to get down; and after anyone was seen coming over the rim Haskell had an hour to hide his stuff. After finishing the set and after trying for many days to work somebody, he decided that what he had told the brigand was no lie.

I had never heard of Haskell before the receipt of his letter. He had been in the war, overseas, from Texas. He had been a ham before the war but out of the game since. Three of his friends in Texas had wised him up considerably on short-wave apparatus. In the use of a .45 pistol he needed no instruction; all he needed was practice, and he got plenty of that down in the volcano. The natives engaged in the chief industry of the district packed plenty of hardware, but, cartridges costing a dollar apiece in their money, they did no practicing—a circumstance that saved Haskell's life on more than one occasion. He and his friend, Paul, the only other white man in the party, had plenty of ammunition. They shot wolves on the run and eagles in the air, partly for practice, largely to keep the natives in a proper frame of mind. On the whole, from things I have since learned and from things he himself has let slip, I gather that sj5BX is pretty hard-boiled.

Now back to that letter. It came while Ralph Heintz, 6XBB, was spending a week-end at 6HM. If you don't know Ralph from his accomplishments let it be said here that he is as far on the plus side of radio as your Uncle Dudley is to the negative. That implies a world of wisdom. Haskell's material was passed across the table to Ralph. Ole Ralph spit on his pencil and commenced forthwith to scatter Haskell's apparatus over a sheet of paper, doubling up on some parts to get the required values and adapting others. When he had arrived at the best he could do with the parts Haskell had on hand he drew out a radiating system and specified how far it must be located from a sidewall of the crater. "Now," he said, "send your friend this dope and I think he'll get his signals out of that hole." I hadn't told him that Watson was a stranger to me, or that in advising him we might be guilty of compounding a felony. In that country no one is allowed to transmit and you can't even get permission to listen.

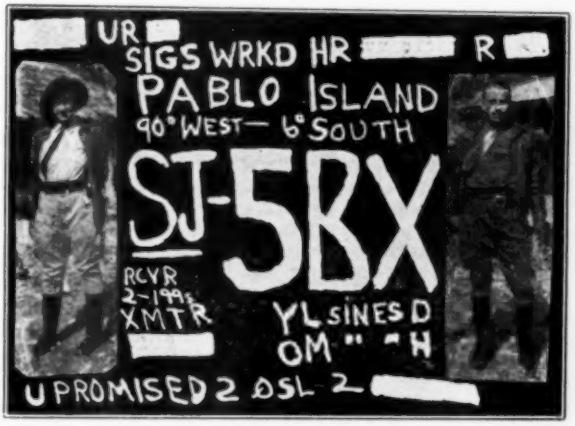
Haskell had said that he was signing the call DON. I told him to locate if possible a little below LP1, down among the Australians. In about three weeks I commenced to watch for this DON, with a d.c. note from a 50-watter and dynamotor. And about that time I had to go to San Francisco. Fred Roebuck, (old KFUH), there at 6ARD, said, "Say, have you heard a station signing sj5BX? Where the dickens would that be? There isn't any such intermediate." Herbert Breuer, 6JN, was with us, and we all did a lot of surmising. The next day, just as I was about to leave the

*W6HM—W2QW. Carmel, California.

hotel for home, Herbert called up with, "Hi! I worked that sj5BX last night! And guess where he is. On Pablo Island, at 90 degrees West and 6 degrees South of the equator." And told me where to look for him. When I reached home I soon found sj5BX, working a Six and giving that same QRA. Also telling the Six, "Not much use sending a card, Old Man, because ships come here only about once a year. Will QSL later." I couldn't find any Pablo Island, or any other kind of an island, at the position named—which would be about 500 miles off the coast of Peru. Then down at our village post-office I met a man who had just been living in Peru. He had never heard of such an island. I explained what the intermediates were for, and that there was no such intermediate as SJ in use. "Oh," he exclaimed, "now I think I can straighten you out on that. The old name for Peru was Juinan." (I leave the pronunciation to those of you who are familiar with Spanish. Those who are not would better leave it alone. It starts with a noise like blowing your soup. Or if you plead not guilty, try, it with the first note of the hoot-owl.) This man said that many of the old-timers refused to use any but the old name, and that this sj5BX was doubtless of one of the old aristocracy of Peru. So that straightened me out fine. And I was just pluming myself over being able to show the boys the breadth of my knowledge when I noticed among the letters I was holding in my hand one with a foreign stamp. These a ham always opens first. "I was afraid of that DON call. It sounded suspicious. So I decided to use a ham-sounding call with an intermediate that nobody could locate." And then the mystery of Pablo Island really was solved. But after that I told many a feller why this old moss-backed Peruvian insisted upon using SJ instead of SP.

Some of you who worked this station will recall that frequently there was a YL at the key. Haskell had taught her the game, and had refused to let her operate the set until she had become letter-perfect. He had done such a fine job with this pupil that he broke his own nose, for she was a dandy operator—better than Haskell. She is a relative of his by marriage, being his wife. And how she did like to bawl a feller out for sending double, or for sending slowly when he could go faster. She was the Helen Wills of the key and you didn't have to soften your game for her! You fellers who worked sj5BX when she was operating will be sorry that you didn't QSO oftener when I tell you that she is as fine looking as she is fine. It is too bad that the foto I have of her and Haskell is not sharp enough to reproduce with this story. They are both well worth looking at.

Aside from the purely radio features of this tale there is enough of the dramatic and human interest in the doings at sj5BX to fill a book. Goodness knows, it is interesting enough to think of transmitting from the bottom of a hole 3000 feet deep. They came near to working all continents.



THE QSL CARD OF sj5BX

Home-made, photographically, with a snap of the YL on the left and of the OM on the right. Haskell made only ten of these cards because he says, "Each one we made took about half an hour, and besides that's enough for one for each district and for a special friend or two."

They would have done so with a little more time. For example, they would have if foA3V had been able to get them thru his QRN the night I had him on Haskell's trail. The story of Haskell's trip out of the crater for some dynamite that he bought from brigands who had taken it in the hold-up of a mine, and the things that happened on his return with this stuff loaded on three burros (there *were* three when he started) would make a thrilling tale all by itself. Or an account of the time when two bad eggs started to shoot up him and Paul one dark night just outside their camp, and ended by going to—wherever it is that assassins go. Or the time when another of these gentry tried to kill the house-servant, and had to be dissuaded permanently. Or the time when Donna and Haskell were all alone and were pounced upon by nine. This last fracas I think I must tell you about, because it is this one that ended the career of sj5BX, and you will want to know how the finish came about.

The Watsons had a parrot from which they were only semi-detachable. I think it was a YL parrot, because it used to sit on Haskell's knee and pull the buttons off his coat. She was devoted to amateur radio —all-same *QST*. Just couldn't keep away from the shack, even when nobody else was there. There were so many nice coils and dials to chew on. That's why you seldom found sj5BX twice in exactly the same spot. And while operating was going on she was doing Babe Ruths around the table and over the operator's shoulders. Once while QSO I got a hurry call to QRX while the parrot was being revived. She had got against the plate coil (TG&P, series feed) and hit for a three-bagger. The air was full of blue language and green feathers.

Well, one bright afternoon of a lazy June, Haskell and this YL parrot were sitting peacefully on the porch of their little camp at the bottom of this extinct volcano, telling one another whom they were going to work that night, when all of a sudden it didn't seem quite so darned extinct. Nine gentlemen, dark-complected on the outside and all the way through, appeared suddenly with their hardware erupting in the general direction of the Watson family. Watson et Ux, always living a life of preparedness, got into action, Donna acting as gunbearer and passing the loaded pistols while Haskell did the shooting. When the smoke finally cleared away two of the dark-complected gentlemen were dead, others were wounded, and the two Watsons were overpowered. As to the YL parrot I am not informed. I think she fainted.

Donna and Haskell were roped up too tight for comfort and cached temporarily in an adobe hut to ponder on the vicissitudes of ham radio. The one thing that they seemed surest of was that after nightfall they would be taken out and shot. But, just to show that you can't keep a good ham down, what happened when darkness came was that a faithful servant—the one who had been rescued when the bad egg was going to kill him—cut the prisoners loose and guided them out into the bush where he had saddled and hidden their horses. They spent seven days getting out to the nearest town over a bandit-ridden trail, riding and walking hours on end in the pitch dark to avoid being seen. They saved nothing except what they had on and enough money to buy two cans of sardines from a native. These sardines and three quail that Haskell shot with a pistol were all the food they had on this ride. And from what I've seen of the amount of stuff that hams can put away at a hamfest I'll say that this picture hits you fellows in a tender spot. At this town they had thought they would be safe, but they found that the news of the rumpus had preceded them and that they were being accused of murdering these men in cold blood. The prospect of being thrown into a filthy jail to await the decision of the law of a lawless land didn't appeal. A stranger, a fellow American, gave them some money and then beat it out of town himself. They hired a Chevrolet truck and an armed guard of eight men. With these they slipped out in the night, headed for a larger town. Most of the eighteen hours of that journey was spent in pushing the Chevrolet over a trail that a jackrabbit couldn't have traversed under his own power.

Having had to bribe so many "officials," they arrived in this town again broke. But another good American came to the rescue and they reached the coast and a ship Eventually they landed where a ham gets a square deal from his government; where 16,000 amateurs were dispossessed of their earned and rightful place on the air by the adroit maneuvering of foreign governments and a comparatively small number of money-seeking commercial interests, but at any rate a country where a ham need not fear going to jail.

Now as to the ethics of the situation; as to the conduct of Haskell's ham friends who were in the know and who had kept his expedition in touch with the outside world: The American Radio Relay League will doubtless disagree with us, for A.R.R.L. is a stickler for the niceties of ham behavior. But this was not just a case of hamming for amusement. Many vital comissions were executed for sj5BX that could not have been handled thru a telegraph station and post-office six hazardous days' ride from him; where all mail and messages were scrutinized, and even their delivery at times denied thru the ignorance and suspicion of officials. I'll say that, when two fellows and the game wife of one of them, go on an expedition that has a perfectly legitimate and laudable aim, into a country where the laws are hand-made from day to day by whatsoever brigand or grafter happens for the time being to be in control, a country so ignorant of the uses of radio that its purposes are regarded as wholly sinister, where large murders for small gains are the rule—I'll say that the ham who had refrained from doing his utmost to aid these people should be read out of any society where there exists a consciousness of right.

Adios, sj5BX. You are a fine guy and a brave gentleman. And so's your OW.

Frequency Stability by Magnetostriction Oscillators

By Harold P. Westman, Technical Editor

PROF. G. W. PIERCE of Cruft Laboratory at Harvard University has published a paper entitled "Magnetostriction Oscillators"[1] which deals with the magnetostrictive characteristics of certain materials and their application to the stabilization of the frequency of oscillations generated by a triod. This article is based upon the material appearing in that paper.

Like quartz plates, magnetostriction oscillators are dependent upon a mechanical vibration for their stability and although it is not possible to obtain satisfactory output at extremely high frequencies such as may be obtained with the piezo-electric oscillator, it is possible that with the devolopment of suitable frequency multipliers that magnetostriction oscillators may some day be of extreme value in amateur work. Magnetostriction deals with mechanical deformation of certain materials when they are subjected to magnetic fields either of constant or varying strength. If for instance, we take a rod of nickel and subject it to a constant magnetic field of 1 gauss, we find that its length has been shortened by about one millionth. This change is extremely small because it must take place against the enormous elastic force of the material. If, however, the magnetic field is not constant but is made to vary in an oscillatory manner at a frequency equivalent to the resonant period of the rod, the deformation of the rod will be much greater because it does not then take place against the elastic force of the body but is opposed only by its viscosity or ability to yield continually when under stress. Under the varying magnetic field, the mechanical lengthening and shortening of the rod may reach a value as great as 100 times that observed with the field constant.

This effect, as one would suspect, works two ways and if we stretch or compress a magnetized rod, we will find that its magnetic field has been altered. The deformation of a rod under a magnetic field may be considered as the direct effect while the change in the magnetic field due to a mechanical deformation may be considered as the inverse effect.

In order to take advantage of these small effects, it is necessary to use a vacuum tube and thus obtain enough amplication to allow sustained oscillations to be produced. Figure 1 gives a schematic diagram of the circuit employed. The rod is placed within two coils and rests at its center on a blunt pivot. It does not have to be critically balanced and may even be tightly clamped at the center if that is desired for any reason.

One of the coils is in the grid circuit while the other is in the plate circuit, much

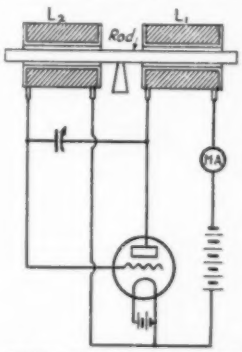


FIGURE 1. THE CIRCUIT ARRANGEMENT FOR OBTAINING MAGNETOSTRICTION CONTROL OF FREQUENCY. The rod rests on the blunt pivot between the coils.

as in the split-coil Hartley arrangement. However, one of the coils is reversed so that feedback from the plate coil to the grid coil without the aid of the rod is not in the proper direction to cause oscillations to be produced. It is possible, though, under certain conditions to cause such a system to oscillate without the use of the rod and as this is not damaging to the stability of the arrangement, it is unnecessary to take precautions to avoid such conditions. A condenser is shunted across both the coils so that the circuit may be adjusted to have a frequency of oscillation equivalent to the period of the rod employed.

Let us assume that the electrical circuit is so adjusted that it is not oscillating of its own accord (without the rod) but that if it did oscillate, it would do so at the same period as the rod. The rod is placed within the coils and the filament of the tube lighted. The plate current will increase as the filament emission becomes greater and this current flowing through the plate coil will cause a magnetic field to be set up about the coil. This magnetic field will act upon the rod and

1. *Proceedings of the American Academy of Arts and Sciences.* Vol. 63, No. 1. This publication may be obtained from the Library of the American Academy of Arts and Sciences, 28 Newbury Street, Boston, Mass., for $.90.

cause it to be deformed (either lengthened or shortened). The deformation will not occur instantaneously along the entire rod but will travel along the rod at a definite speed depending upon the hardness of the material of which it is composed. When the deformation reaches the end of the rod that is within the grid coil, the inverse effect will take place and the magnetic field surrounding the rod will be varied because the physical dimensions of the rod have been altered. This change in magnetic field will effect the grid coil and induce a voltage therein which will be applied to the grid of the tube. This voltage applied to the grid will be amplified and will result in a change in the plate current which will start the cycle again by causing a change in the magnetic field around the plate coil through which it flows. In this fashion the circuit is made to oscillate at a frequency that is dependent upon a longitudinal or lengthwise vibration of the rod, the frequency of which will be controlled by two factors, namely; the length of the rod and the speed at which the deformation is propagated along the rod. This last mentioned factor may be controlled by the choice of the material employed and varies with the velocity of sound in the material. In general, the harder the material, the higher will be the velocity of sound through it and the higher will be its natural period of vibration.

In order that oscillations be produced, the rod must be magnetized and the varying magnetic field is superimposed upon the steady one. This will result in an increase in the magnetization of the rod when the varying field is in one direction and a decrease when it is in the reverse direction. If the rod were not magnetized to start with, the varying field would not cause an increase and decrease but would result in only an increase (or decrease) which means that the length of the rod would increase (or decrease) twice for each cycle rather than give *both* an increase and a decrease for each cycle which is desirable.

The rods may be permanently magnetized by inserting them into a solenoid and passing a heavy direct current through it. The field due to the direct plate current will aid in keeping the rods permanently magnetized and when in this condition the rods should be marked so that they are always inserted in the same direction. It should be unnecessary to have to remagnetize them as most materials will hold their magnetization in spite of the effect of the varying field in which they are operated. At all times, the steady field should be greater than the varying field.

In materials that have but little ability to hold their magnetism, the steady field may be obtained from a small permanent horseshoe magnet which is placed near the rod. It is not necessary or desirable to have the permanent magnet touch the rod and it may be located several inches from it.

In Figure 2, some experimental curves taken on a rod of Nichrome are illustrated in the circuit arrangement shown in Figure 1. The upper curve shows the change in wavelength obtained for a given rotation of the tuning condenser shunted across the coils. The rod was first held to prevent it from vibrating and the curve ABCDE was obtained which indicates a change in wavelength of from 16,000 meters at 19 degrees of the condenser dial to 19,400 meters at 30 degrees or a change of 3,400 meters for a dial rotation of 11 degrees.

Next, the rod was allowed to be free to vibrate and the condenser rotated from a low reading towards maximum. The curve ABCD'E was then obtained and it will be noted that over portion indicated by D' there is no readable change in wavelength. The condenser was then rotated from maximum towards minimum and the curve EDCB'A resulted. This shows a constant wavelength along the portion of the curve B'. After the rod has started to vibrate it is possible to vary the condenser from 18 to 30 degrees without shifting the wavelength. Thus, over a range of the condenser that gives a wavelength shift of 3,400 meters without the rod, there is no readable wavelength change when the rod is in vibration.

It was impossible to read any shift of wavelength along the stabilized portion of the curve when a precision wavemeter was employed as the measuring device and so some other method must be used to show how much the frequency does vary. Another magnetostriction oscillator was set up and a rod having a frequency of about seven times that of the rod under test was set vibrating. The seventh harmonic of the rod under test would then beat with the fundamental of the second oscillator and a change of one cycle in the test oscillator would cause a change in the beat note of seven cycles. The beat note could be measured to about one cycle which would be equivalent to a shift of but one seventh of a cycle of the rod under test. As will be seen by the second curve of Figure 2, a change of the condenser from 19 to 30 degrees with the rod vibrating causes frequency change of only 1.5 parts in 17,000.

The lower curve of Figure 2 indicates the change in plate current as the capacity across the coils is varied. As the capacity is increased from a low value, the current follows the solid line and when the reverse rotation takes place the current varies as shown by the dotted line. The jump in current of two to four milliamperes takes place as the rod starts to vibrate and the smooth tapering of current as the conden-

ser is reduced towards 18 degrees is due to the fact that the particular circuit conditions caused the electrical oscillations (those not due to the rod but to the electrical circuit alone) to stop when the value of the condenser was less than 18 degrees. Otherwise, the characteristics shown at the higher capacity setting portion of the solid line curve would be duplicated at the lower capacity end of the dotted line.

It must be remembered that in the measurements just cited, the capacity across the coils was varied over a wide range to cause as large a change in frequency as possible and that in actual use, the capacity will always be set at a value that gives the highest plate current. It will, therefore, be possible to obtain a much higher degree of precision in the resetting of the equipment than the possible error shown by the curves might indicate.

We may regard the operation of this system over that portion of its range where frequency stabilization takes place as being equivalent to an inductance-capacitance circuit in which the inductance varies enormously with a change in frequency. We may represent the wavelength-against-capacity curves of Figure 2 by the following equations:

$\lambda_a = 2\pi c\sqrt{L_a(C+C_o)}$ for the damped curve

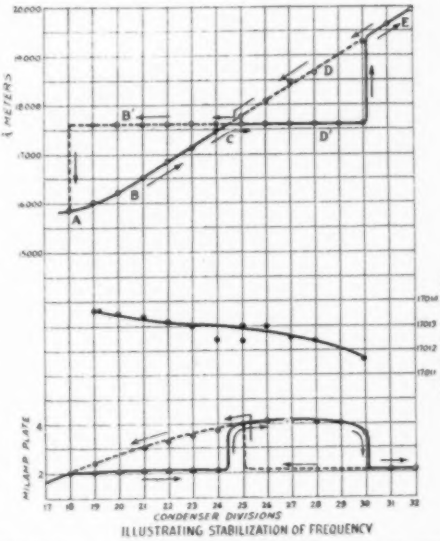
$\lambda_f = 2\pi c\sqrt{L_f(C+C_o)}$ for the free curve

from which we obtain

$$\frac{\lambda_f^{\,2}}{\lambda_a} = \frac{L_f}{L_a}.$$

Figure 3 gives the values of this ratio plotted against frequency from which it appears that the change in inductance of the coil and free rod is about 50% for a change in frequency of less than 1/100 of 1% over that range in which the stabilizing action is operative. We may, therefore, consider that if the capacity across the coil is reduced, the shift in frequency causes an increase in the inductance of the rod and coil so that the product of the inductance and capacity is almost the same as it was before the change was made. Likewise, any increase in capacity will cause a decrease in inductance to an amount that will still compensate and the product of L x C will be nearly constant. Thus, if the rod is not used, a change in capacity of 50% will result in a frequency change of 25% whereas with the particular rod under test, this change of capacity results in a frequency change of but 1/100 of 1%.

The comparison was made between the rod and a quartz crystal mounted in a vacuum and held in an accurately designed and carefully machined mounting. Repeated measurements indicated that when this crystal was operated under constant conditions, which must be very carefully checked, that an accuracy of frequency of 1/500 of 1% could be maintained. However, when the circuit conditions for the crystal are changed over as great a range as indicated for the rod, the frequency of



ILLUSTRATING STABILIZATION OF FREQUENCY

FIGURE 2. THE UPPER CURVE SHOWS THE STABILIZING EFFECT OF THE VIBRATING ROD WHEN THE ELECTRICAL CIRCUIT IS DETUNED AS COMPARED WITH THE ELECTRICAL CIRCUIT ALONE. The second curve shows just how much the frequency does change when the electrical circuit is detuned and the rod is vibrating. This curve is equivalent to the horizontal portion of the upper curve very greatly amplified. The lower curve shows the behavior of the plate current of the tube as the rod starts to vibrate.

the crystal would vary as much as 7/100 of 1%. Thus, the magnetostriction oscillator shows greater constancy under widely varying conditions than does the piezo-electric plate.

The particular Nichrome rod under test showed a variation of 1/93 of 1% for each degree Centigrade change in temperature which is not as good performance as is obtained with the crystal, which changes between 1/200 to 1/1000 of 1% per degree Centigrade. However, by the proper choice of materials it is possible to construct rods having as good a temperature coefficient as is obtained with the crystal. In any case, it is only necessary to know the temperature in order that the proper correction factor may be applied. The effect of temperature is not permanent and rods calibrated at a definite temperature will hold their calibration as long as they are operated at that temperature even though their temperature may have varied considerably in the meantime.

There are various materials that may be

used and the main requirements are that they have large magnetostrictive effects, that their frequency of vibration stay constant in spite of varying temperature and magnetizing force and that changes in the condenser settings, tube characteristics and plate and filament currents shall cause but small change of frequency.

Pure iron and irons with various carbon contents are not suitable because the magnetostrictive effect is very small. Pure nickel is a very active vibrator but its period of vibration will change when the electrical circuit is detuned.

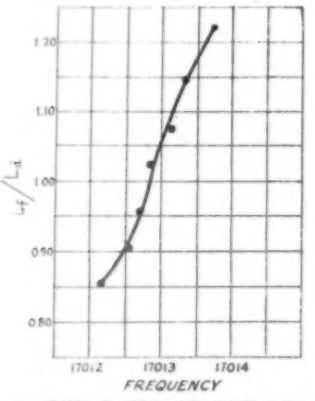


FIGURE 3. THE RATIO OF THE CHANGE OF INDUCTANCE PLOTTED AGAINST FREQUENCY.

Certain alloys of nickel and iron are good vibrators and those having about 36 percent nickel and 64 percent iron, which is about the constitution of invar and stoic metal, are good. Unfortunately, though, their change of frequency with a change of temperature is rather high.

Nichrome and other alloys of chromium, nickel and iron are good vibrators. Perhaps commercial Nichrome is one of the best of the more easily available materials for many purposes.

Monel metal containing 68 percent of nickel, 28 percent of copper and small amounts of iron, silicon, manganese and carbon is a very powerful oscillator but usually requires an auxiliary polarizing device because of the small residual magnetisim.

Alloys of cobalt and iron are strong vibrators.

Tubes of nickel may be used for qualitative work, demonstration purposes and for sources of sound and while they are good oscillators they are not so constant in frequency as might be desirable. Such tubes may be wholly or partly filled with lead or type metal which will result in their period of vibration being materially lowered. This is due to the fact that the velocity of sound in lead is low. By this means it is possible to obtain rods of low frequency without the use of an excessive length.

Composite rods may be used in order to reduce the effect of temperature upon the frequency of vibration. If a tube of nickel which has a negative temperature coefficient has inserted within it a tightly fitting core of a material such as stoic metal which has a positive temperature coefficient, the resultant rod may be made to be practically independent of temperature. These rods are concentrically composite.

Another type of composite rod consists of three rods soldered end to end. The center section is of a material having a soefficient of one sign while the end sections are of a material, the coefficient of which is of the opposite sign. These rods are longitudinally composite.

The frequency at which the rod will vibrate depends upon its length and upon the material of which it is composed. The following table gives the length and frequency of some stoic metal rods which are 0.79 cm. in diameter. The temperature is 20 degrees Centigrade.

Frequency in Cycles Per Second	Length in Cm.	Length in Meters X Frequency
10001	20.815	2081.7
14981	13.87	2077.8
20003	10.40	2080.3
24992	8.33	2081.8
29981	6.93	2077.7

The frequency values given in the above table are accurate to within 1/100 of 1%. Because the ends of the rods are not absolutely true, errors in their measurement may be as great as 0.1 mm. which amounts to more than 1/10 of 1% for the shorter rods. If the length of the rod is multiplied by the frequency of vibration, the constants which appear in the third column are obtained. The variations in these figures are

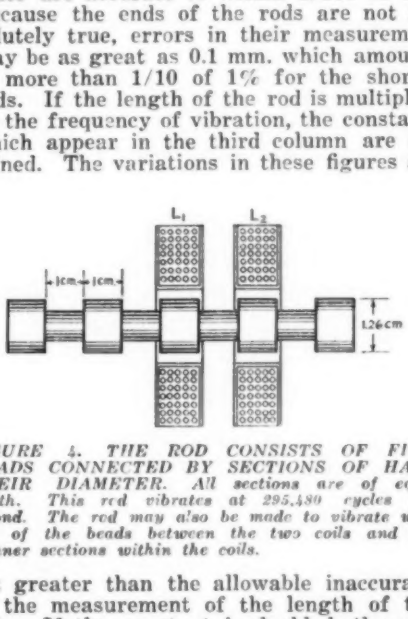


FIGURE 4. THE ROD CONSISTS OF FIVE BEADS CONNECTED BY SECTIONS OF HALF THEIR DIAMETER. All sections are of equal width. This rod vibrates at 295,480 cycles per second. The rod may also be made to vibrate with one of the beads between the two coils and the thinner sections within the coils.

not greater than the allowable inaccuracy in the measurement of the length of the rods. If the constant is doubled, the vel-

ocity of sound in the material is obtained which for stoic metal is:

V — stoic = 4160 2m/sec at 20° C.

The diameter of the rods is approximately the same and as there is no progressive change in the constant it indicates that there is no appreciable end correction for the determination of velocity.

Accordingly, the length of a rod to give a definite frequency can be computed closely enough so that after having been cut in a lathe the final adjustment may be made with but a slight amount of grinding. If the grinding is carried too far so that the frequency of the rod becomes higher than the desired value, it is possible to correct this by grinding away some of the girth of the rod at its center.

This next table gives the values for a series of Nichrome rods 0.96 cm. in diameter at 23° C.

Frequency in Cycles per Second	Length in Cm	Length in Meters X Frequency
29992	8.27	2480.3
35002	7.13	2495.6
40004	6.23	2492.2
45008	5.53	2488.9
49996	4.99	2494.8
55014	4.53	2492.1

The magnetostriction oscillator is most valuable at frequencies below 25,000 cycles per second particularly in view of the fact that the quartz crystal is extremely expensive at these frequencies. Between 25,000 and 300,000 cycles the oscillators have a common field of usefulness. The crystal oscillator has more value at frequencies above 300,000 cycles because although the magnetostriction oscillator is active up to 2,000,000 cycles per second, its output is extremely feeble and it is more desirable to employ harmonics of lower frequency rods if points in this range are desired. Frequencies up to several millions per second may be obtained by means of such harmonics.

The higher frequencies (300,000 cycles) may be obtained by three different types of rods. One method is to place very short cylinders within the plate coil with their axes parallel to the magnetic field of this coil. A second method is to use flat sheets or strips of material which are placed between the plate and grid coils and a third method is the use of a beaded rod.

Fig. 4 gives some idea of the shape and position of the rod. The rod was originally 1.26 cm. in diameter and 9 cm. long. Four grooves that are ½ the radius deep are cut. They are 1 cm. wide and 1 cm. apart. The vibrator then consists of 5 beads, each of which is 1 cm. long and is separated from each other by 1 cm. When the rod was placed so that one bead was within one coil and the adjacent bead within the other coil or when one bead was between the two coils, the rod vibrated at a frequency of 295,480 cycles per second. The rod is of stainless steel, the velocity of sound through it being 5,430 meters per second and the length of a vibrator to give this frequency is:

Length = 543,000 ÷ 2 x 295,480 = .918 cm.

This is about 10% less than the computed value of one of the beads standing alone when regarded as a linear vibrator. The system is resonant at other frequencies, the strongest indication being at 19,888 cycles per second.

It is interesting to note that rods of large diameters may be made to vibrate at high frequencies. A thin disc 1.5 cm. in diameter and only about 2 mm. long can be made to oscillate at a frequency of about a 1,500,000 cycles per second. The disc is mounted between corks in a glass tube. Its oscillations are very feeble and are in-

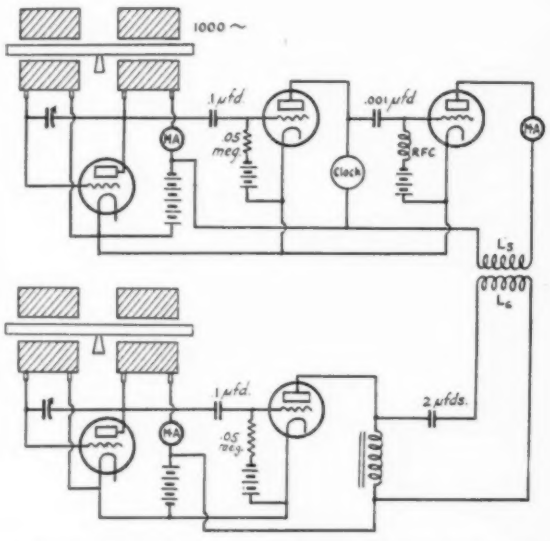


FIGURE 5. THE CIRCUIT ARRANGEMENT FOR COMPARING TWO OSCILLATORS. The upper circuit is controlled by a 1000-cycle rod, the frequency of which is checked by the synchronous clock in the plate circuit of the second tube. The third tube amplifies the harmonic of the 1000-cycle source that beats with the fundamental of the second rod which appears in the lower circuit. The outputs of the two circuits are coupled together through L5 and L6 and the beat difference noted on the milliammeter.

dicated only by the clicks heard in the telephone receivers when the tuning condenser causes the electrical circuit to pass through the resonant period of the rod.

There are many uses to which these standards may be put and it is possible by means of one rod to obtain points over an extreme range of frequency. These are obtained by the use of a second oscillator, the frequency of which may be varied over wide limits. When higher frequencies than the fundamental of the rod are desired, a harmonic of the second oscillator may be made to beat with the fundamental of the magnetostriction oscillator and if additional points are desired they may be obtained by beating harmonics of the electrical oscillator against harmonics of the rod oscillator.

When calibrating a frequency meter from a rod, the meter is short-circuited and placed near the electric oscillator coil. The electric oscillator is adjusted so that its fundamental (or harmonic) is at zero beat with the harmonic (or fundamental) of the rod oscillator. The frequency meter short-circuiting switch is then opened and as resonance is approached by rotating the dial of the meter, audible beats will be heard which rise in frequency and fall to zero beat again. A further rotation will cause audible beats to be heard again which once more drop to zero. When the frequency meter is adjusted to that position giving zero beat upon each side of which audible beats are obtained, all three units are in resonance (either at their fundamental or a harmonic frequency).

Rods may be calibrated in the following manner. A rod vibrating at the rate of 1000 cycles per second is employed to drive a synchronous clock. By means of weights which may be clamped to it and moved nearer together or further apart, the frequency of the rod can be accurately set. The frequency of one such rod could be varied over a range of about 7 cycles by this means.

A pair of circuit-making contacts are closed for a short period of time each second by the synchronous clock. Electrical impulses supplied each second by a standard clock are passed through these contacts to a loud speaker and when the ticks are heard in the loud speaker it indicates that the standard clock and the synchronous clock are in step. The number of seconds in which the two clocks are out of step indicates the difference between the length of the second of the standard clock and the length of the second of the motor driven clock. Several successive intervals may be timed and an average taken from which the rate of vibration of the rod may be obtained.

The timing of the 1000-cycle rod could be made directly because the synchronous clock was designed to be driven by a 1000-cycle wave. However, if a higher frequency rod is to be calibrated it will be necessary to beat a harmonic of it against the 1000-cycle rod. The 1000-cycle rod is adjusted to zero beat with the nearest harmonic of the rod to be calibrated and the vibrations of the 1000-cycle rod checked against the standard clock. The exact frequency of the 1000-cycle rod may be obtained from which can be computed the frequency of vibration of the smaller rod. It is not necessary to depend upon the beats as heard in the telephone receiver because a d. c. milliammeter made be connected into the circuit and a visual indiction obtained.

Fig. 5 shows the circuit arrangement for comparing the two rods. The motor-driven clock takes the place of the choke that would be used for coupling between the first and second amplifier stages. The second stage is used for amplifying the higher frequency harmonic of the 1000-cycle rod circuit and the small coupling condenser between its grid and the plate of the first stage tends to reduce the amplification obtained on the fundamental frequency. A radio frequency choke connected across the input of the grid circuit of the second stage also aids in reducing the amplification of the 1000-cycle fundamental frequency, still allowing the high frequency harmonic to be amplified. The two output circuits are coupled by means of the coils L5 and L6 and as the beat frequency approaches zero it will be indicated visually on the milliammeter. The motor-driven clock may therefore be used to standardize both rods at the same time.

While magnetostriction oscillators may not be directly applicable for the stabilization of transmitter frequencies in the amateur bands, this does not indicate that they are of little or no use to the amateur. Their use in the calibration of frequency meters is extremely valuable particularly when one realizes how much cheaper it is to obtain a series of rods as compared to the cost of an equal number of quartz plates.

We have already accepted frequency doublers in our crystal-controlled transmitters and there is no reason why we may not find it to our advantage to pick off a more remote harmonic of a magnetostriction oscillator for the stabilization of our emmitted frequency. The rod is inexpensive and extremely rugged; two factors which are decidedly important from the amateur view point.

Some Suggestions For 1929

By H. M. Walleze*

MAYBE you have built that new 1929 transmitter and find that the wave is not as steady as the book says it should be, or you have just revamped your plate supply to get a good clean-cut smooth tone but have found that it has a rattle in it. Since my daily grind takes in locating and fixing all kinds of such troubles in about all kinds of transmitters, it is natural that I have learned some of the kinks. Not having seen many such stunts described I want to pass a few suggestions along to add to the many excellent articles that have appeared in *QST* designed to take the hay-wire out of amateur radio for 1929

At the last Atlantic Division Convention at 8XE I made a remark at a general argument session to the effect that 1929 signals should be strictly pure d. c.! I wonder now how I got home alive and in operating condition! I was almost hauled down and only one brave lad backed me up—after the meeting. The cry was the hardship it would work on the amateur existing on the plunder from kid brother's nickle bank. One already had a 30-henry choke and 6 mikes and still no sign of d. c. and wanted to know how he was going to get the required 150 henrys and 300 mikes more. The answer is that either the filter or the rectifier is badly overloaded or the set very poorly adjusted. Considering the tons of good information already printed on circuit adjustment, the trouble must lie in one or both of the two items first mentioned.

We have heard considerable about brute filters but little on common sense filters, as some one put it. The fellow who hangs a 30-henry choke and 10 mikes on a motor generator has more money that horse sense. I have yet to see a machine, built for radio work, that required over 3 to 5 microfarads in conjunction with a good choke of from 2 to 5 henrys providing many other things are as they should be. To begin with, the condensers must be good ones and the chokes must be large enough (talking of copper and iron) so that the current passed through them is not over 75 percent of their rating and for many of the chokes which the amateur uses the current should not exceed 50 percent of the rating.

If you are using rectified a. c. be sure that the rectifier tubes are plenty large enough so that they can be run somewhat under their rating, which will result in greatly improved voltage regulation and among many other things the life will usually be increased. The same thing applies to the plate transformer which should be capable of delivering considerably more power than it is called upon for. If you want good regulation the chokes and transformers must be husky and it is only by good regulation that one can hope to have a signal that is not full of key chirps. Running power tubes underrated has been greatly stressed but it must be remembered that the same applies to every piece of equipment in the set. One way to check the quality of your equipment is to put a brick on the key, just as you have been running everything, and then take in a good show. When you come home, three hours later, the set most probably won't be running. Something burnt up. Throw that something out and get another that will stand up to that treatment or else cut the input until your toy "something" can handle it. Any set that can't run half a day full tilt is hay-wire, somewhere.

Perhaps you have cooked the set overnight without a fire, have everthing underloaded and have spent much time in making fine adjustments according to the information given in *QST* and you still find that the would-be pdc note is fine a. c. Well, quite likely you have your rectifier and filter crammed within 3" of the r. f. circuits thereby pumping plenty of r. f. into these units. Besides losing good r.f. you lose a good note because no filter and rectifier can operate properly with a lot of r.f. floating around in it. Even though nothing blows up, the filtration will be poor. Moving this equipment well away from the set and inserting an r.f. choke (plenty of turns on a small diameter tubing) in each supply lead may fix it. If not, quite likely your filament heating transformer is set on the same shelf as the r. f. equipment and the core iron is a little loose and hums quite a bit. The transformer is then just bouncing around at about 120 j.p.m. (jumps per minute), the tube element jumping along with it at the same rate, especially the filament, if it is a little aged and stretched, a lead or so right in phase with them helping matters along. The result is a modulation of the radio frequency wave at 120 cycles plus a few high kicks thrown in for good measure by the keying relay which is probably stuck up on the frame somewhere. Set these units up on sponge rubber after firmly clamping the core of the transformer or, better still, move them out where they can't shimmy the r.f. parts.

If you are using a motor generator with-

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out a bag or two of cement under it, the same thing probably happens. The machine vibrates, the floor ditto, and the set and signals as well. Even though heavy rigid wiring may be used in the set the chance of vibration is good and it does not take a great deal to spoil an otherwise good note. If the machine is not too large, a bundle of paper towels under each end will fix both the rattle and the signal as well as the rumble down in the OM's bedroom which will help some on midnight work.

The generator may be stirring up a grand hash at the commutator which finds its way to the set via high voltage leads or, more likely, by direct radiation from the machine itself. Move it away or put it in a tin can but don't forget to cut some air-holes which should be covered with copper screening. The can, motor generator frame and the negative lead, should all be connected to a good ground. This may also quiet the BCL across the street.

Perhaps a couple of pointers regarding the crystal-controlled transmitter might not be amiss. Unless you are looking for trouble, the r.f. choke in the grid circuit of the crystal tube should not be so constructed that its natural period falls near that of the crystal. If it does, the circuit will tend to oscillate without the aid of the crystal; being simply an Armstrong circuit. While with proper adjustment, the crystal will control the frequency and the output may be materially better, the increase in the r.f. voltage applied to the grid and consequently across the crystal, may be great enough to rupture the plate. It should be possible to remove the voltage from the amplifier tubes and the quartz plate from its holder and then when the oscillator tank condenser is rotated through its entire range there should be no tendency for the circuit to break into oscillation. If it does oscillate, add some more turns to the r.f. choke until the proper condition can be obtained.

While we are on the question of chokes, why not operate the transmitter with series plate feed so as to reduce the amount of work which the choke is being called upon to perform. If there is any difference in performance between the series and parallel methods of feeding, it is so slight that in actual practice it is negligible.

The same thing applies to the use of biasing batteries as compared with the use of resistors. If variable resistors are used the results obtained will approach so closely to those obtained with the use of biasing batteries that one would have to sit up about 400 nights a year to hear the difference, granting both are properly adjusted. The use of resistors means a lot to the slim bank account as well as in the amount of constructional work necessary. Of course, if the voltage regulation is not good, the bias may vary considerably but that cannot be blamed on anything but the power supply system.

As far as the receiver is concerned, it should not be considered a disgrace or even a luxury to put a cabinet around it. The "box" won't affect the signal providing it is constructed of good dry lumber and well treated with high grade clear varnish. Don't smear it up with pole paint or something worse.

While many claim that resistance control of regeneration does not give as good signal strength as some other method. If it is built correctly, it will do just as well and perhaps better. Instead of trying to work with a small diameter tickler coil stuck a foot from the secondary, make it the same diameter as the secondary and put it not more than ¼" away from it. Cut the tickler turns down to 2 or 3 for the higher frequency bands and run the detector plate voltage up to 30 or 35, if necessary. If your tuning condenser is as small as it should be and has a good vernier dial you will then have an ideal receiver with but one tuning control. The regeneration control won't change the note and you can work the detector tube at the point where greatest sensitivity is obtained. There will be no necessity for "edging" up on the regeneration control in order to hold your signal. If you insist upon two tuning controls put in a stage of tuned radio frequency—then sit up some more nights and figure out how much *necessary* gain you have obtained against all the fuss and cost.

Strays

3AJC had some grid leaks of the coated glass filament variety which were getting noisy after about a year's use. Upon chemical investigation, it was found that the resistance material was germanium, a material which tends to crystalize at the end of about twelve months.

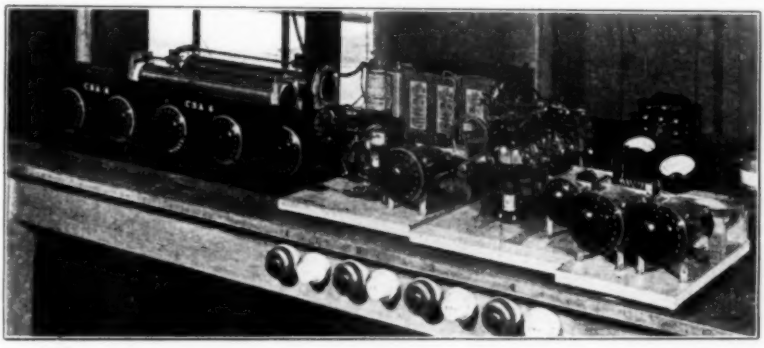
The Radio Division, Department of Commerce, has appointed seven new Assistant Radio Inspectors, with four more contemplated. The new men are receiving training at the District Supervisors' offices and will then be placed at new branch offices which the Department is opening at Buffalo, Dallas, Denver, Los Angeles, Minneapolis and Omaha.

7OK tells us that he was using the condensers out of Ford coils for filters. The first batch he had blew at 850 volts and the second batch has been working on 750 without any sign of going West.

A 28-Megacycle Crystal-Controlled Transmitter*

By Howard Allan Chinn†

DURING the past few months nu1XM maintained automatic transmissions on 28 megacycles during certain periods on Saturdays and Sundays in an effort to obtain data relating to wave propagation in this high frequency band recently opened to amateurs, and to provide those hearing the transmissions with a definite point in the frequency spectrum. The transmitter was crystal controlled and the frequency known to be 28 megacycles, within .1 of 1%. This article, describing the transmitter used, is presented not because of any new or radically different features involved but rather to show the straightforward arrangement of a 28-megacycle crystal controlled transmitter. The procedure and circuit arrangements are not limited to 28 mc. operation but can be modified for operation in any waveband.



THE TRANSMITTER WITH THE CRYSTAL OSCILLATOR AND FOUR FREQUENCY DOUBLERS PANEL-MOUNTED AT THE LEFT

The crystal holder may be seen at the extreme left. Two slide wires behind this unit are used for the resistors R6 and R7. The first breadboard at the left holds the UX-210 frequency doubler and the second board has the pair of 852's mounted upon it. The midget condenser hanging up in the air above the inductance is the grid tuning condenser to tune the input circuit of the two 852's. The neutralizing condensers are mounted on the shelf above the horizontal arms of the 852's. The breadboard on the extreme right holds the two antenna condensers, the antenna inductance and meter. The two coils behind this board are similar to those used in the frequency doubler circuits. The "B" batteries supply bias for the 210 and 852's.

The transmitter was assembled of units that were available at the time and as can be seen from the photo, is half panel and half breadboard in construction. The apparatus, being primarily designed for laboratory experimentation, is not especially compact, as a permanent installation could undoubtedly be. The crystal used has a fundamental frequency of 1.75 megacycles and therefore four frequency doublers were necessary. From the circuit diagram we see that the crystal oscillator tube and the first three frequency doublers are UX-201-A tubes. Somewhat greater output can be obtained by using UX-112-A tubes in these positions, but in this particular case the UX-201-A tubes were found entirely satisfactory. The fourth frequency doubler is a UX-210 tube which provides the 28 megacycle voltage to excite the grids of the two UX-852 tubes which are operating as straight amplifiers.

The reason for operating the last stage as a straight amplifier and therefore necessitating some form of neutralization was because it was found that when tubes were used as frequency doublers they operated rather inefficiently. Thus, to obtain a given output from a tube it is necessary to operate it with a considerably higher plate dissipation when used as a frequency doubler as compared with that when used as a straight amplifier. Since most of us run our tubes at a maximum safe plate dissipation anyway, it follows that the logical way

*Contribution from the Round Hills Shortwave Radio Research.

†Electrical Communication Laboratory, Massachusetts Institute of Technology, Cambridge A, Massachusetts.

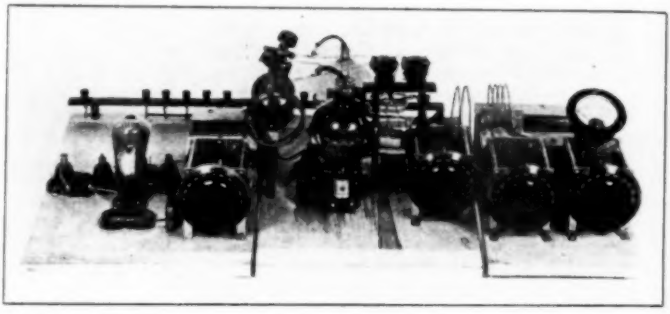
to obtain most output from a given tube under normal operating conditions is to use it as a straight amplifier rather than as a frequency doubler. The apparatus as originally set up employed the last tubes as frequency doublers (one of the UX-201-A stages being omitted) but the output was far from satisfactory and the tubes ran too hot. By the addition of one UX-201-A the and last stage converted into a straight amplifier the output increased many times with the same input power.

The neutralization arrangement used in the last stage is of interest and its operation is readily seen from consideration of Fig. 2.

Figure 2a shows the last stage amplifier schematically without the power supply, by-pass condensers, etc., and with the grid-plate inter-electrode tube capacities indicated. It is because of feed back through these capacities that the circuit will oscillate. Figure 2b shows the equivalent circuit involving these tubes and the neutralizing condensers. The points P_1 and G_1 can be thought of as representing the grid and plate terminals of tube 1. Likewise C_{gp1} represents the grid-plate capacity of tube 1. The circuit can be further unscrambled as shown in Figure 2c. Here we see we have an ordinary capacity bridge, the points being lettered the same as in Figure 2b. Thus we see that if the two neutralizing capacities are equal to each other and to the grid-plate capacity of the tubes being used, the bridge will be balanced and any voltage introduced between the points G_1 and G_2 will have no effect upon the bridge points P_1 and P_2. Thus we see that in adjustment of the circuit we will expect to find the two neutralizing capacities about alike and equal to the grid-plate capacity of the tubes plus any stray capacity due to sockets and wiring. The average grid-plate capacitances of the more common tubes are as follows:

Tube	Grid to Plate Capacity (based tube)
UX-201-A	10.1
UX-112-A	11.0
UX-210	8.0
UV-203-A	22.5
UV-211	18.5
UV-201-A	19.0
UV-851	57
UX-852	2.5

Besides lending itself to easy neutralization the balanced circuit used for the last stage amplifier has the further advantage that when properly adjusted, practically no radio frequency flows down the center tap leads to the filament or plate supply circuits. The proper point for the center-tap leads (those going to the C minus and B plus) would be to the exact center of the grid and plate inductances if everything were balanced and symmetrical. Different length leads (this should be avoided as far as possible) from the tubes to the inductances may cause a slight unbalancing and therefore the exact points to which the center-tap leads are connected should be found by trial. These voltage nodes may be found by using a screw-driver (or a neon tube) and locating that point on the inductance from which no arc can be drawn. It should be noted that both inductances are "high" above ground and care must be taken to avoid shocks from the plate and grid supplies. In order to avoid any radio frequency current that does come down the center-tap leads getting into the power supply, both the B and C battery terminals are by-passed and provided with r.f. chokes. Incidentally, it might be well to suggest that if you have any sensitive r.f. meters about it is wise to remove them a considerable distance from a 28 or 56 Mc. (ten- or 5-meter) transmitter. Thermocouple meters that were thirty feet from this transmitter and had their terminals *shorted* have been seen to go half-way upscale.



AT THE LEFT IS THE LAST FREQUENCY DOUBLER, A UX-210

This sows somewhat more clearly the input circuit to the pair of 852's and the two neutralizing condensers. The breadboard on the right holds the antenna tuning equipment as well as the meter.

For convenience, the first four coils, L_1, L_2, L_3, and L_4 were wound on bakelite tubing and equipped with G. R. plugs. While this method did not permit the use of adjustable taps that would have permitted a more efficient operation of the frequency doublers, it makes for simplicity and quick interchange of inductances when necessary. Thus the apparatus may be used with a crystal of any fundamental frequency and proper coils quickly plugged-in. In the set-

up, as actually used, a switching arrangement was included to cut out or by-pass as many of the frequency doublers as was desired in order to make the apparatus as flexible as possible.[1] This is shown in Fig. 3.

The coil and condenser values used are given in Figure 1. The values for C_1, C_2, C_3 and C_4 are the approximate capacitance values actually used. The condensers were all National 500-μμfd. receiving condensers, adjusted to these values. C_5 and C_7 were National 150-μμfd. transmitting condensers adjusted to the values indicated in the figure. C_6 and C_{18} were General Radio 15-μμfd. midget variable condensers, the latter being doubly spaced.

The plate voltage applied to the UX-201-A tubes was approximately 200 volts. This was obtained from the 500-volt plate supply to the UX-210 by suitable resistors R_6 and R_7. It was necessary to use two resistors, and not one common one, since it was desired to key in the plate circuit of the last UX-201-A frequency doubler. If a common resistor were used and the plate circuit of this tube opened the voltage on the remaining 201-A tubes would rise to a dangerously high value. The plate supply for the 852 tubes was 2000 volts and was obtained from a 2000-volt generator having four commutators which permitted the use of a 500-volt tap for the first five tubes.

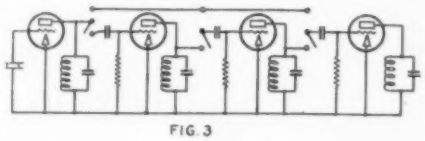
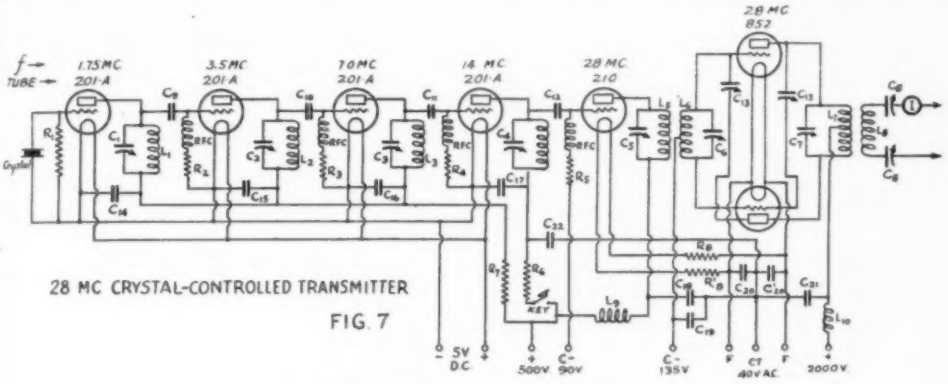


FIG. 3



28 MC CRYSTAL-CONTROLLED TRANSMITTER

FIG. 7

THE COMPLETE CIRCUIT DIAGRAM. THE CONSTANTS ARE AS GIVEN BELOW.

L1—32 turns of No. 18 d.c.c. wire on 3 inch form.
L2—14 turns of No. 18 d.c.c wire on 3 inch form.
L3— 4 turns of No. 18 d.c.c wire on 3 inch form.
L5 and L7—2 turns of spaced edgewound copper ribbon.
L5 and L7—2 turns of spaced edgewound copper ribbon.
L6—8 turns same as L5.
L8—4 turns same as L5.
L9 and L10—G.R. choke No. 379-T.
RFC—Samson choke No. 85.
C1 and C2—125 μμfds.
C3—225 μμfds.
C4—90 μμfds.
C5 and C7—75 μμfds.
C6—15 μμfds.
C8—30 μμfds.
C9, 10, 11, 12, 18, 19 and 21—.002 μfds.
C13—Double spaced G.R. midget. Capacity probably about 15 μμfds.
C14, 15, 16 and 17—.006 μfds.
C20—and C22—.01 μfds.
R1, 2 and 3—.5 megohms.
R4—50,000 ohms.
R5—zero.
R6—30,000 ohms.
R7—13,000 ohms.
R8—1 ohm.

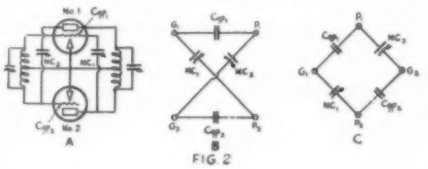


FIG. 2

1. This entire unit was built over a year ago by R. L. Briggs in carrying out his thesis at Massachusetts Institute of Technology.
2. *QST*, p. 19, March 1928.

The filaments of the 852's and the 210 were fed from a ten volt a.c. source while the 201-A's happened to be lighted from a storage battery although they might just as well have been arranged for operation on a.c. The filament voltage for the 210 tube is dropped from ten volts to seven and one-half by the series resistors R_s, two being used, one in each side of the line in order that the center tap would not be unbalanced. Small resistors of various values suitable for such purposes may be obtained from several manufacturers.

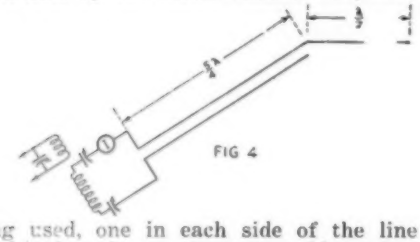
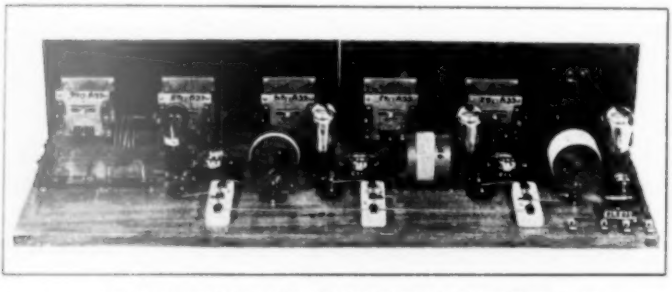


FIG 4

In order to facilitate tuning of the transmitter, a 125-milliampere thermo-couple meter or thermo-galvanometer, shorted with a single three-inch turn of wire was used. The single turn is first coupled to the inductance in the plate circuit of the crystal oscillator tube and the condenser varied until the indication is at maximum. The coupling should be kept as loose as possible in order that the effect of the meter and coupling coil on the tuning of the circuit is a minimum. The meter is next coupled to the coil in the plate circuit of the first frequency doubler and this circuit is tuned until a maximum indication is again obtained. In order to make certain that this tank circuit is tuned to the second harmonic of the crystal a frequency-meter should be coupled to the coil and the frequency checked. It is quite possible with suitable coils to tune this tank circuit to the third or fourth harmonic and to obtain rather weak tank circuit current. This procedure is repeated until all the frequency doublers are in tune, including the 210 stage. With the meter coupled to the coil in the plate circuit of the UX-210 all the condensers can then be slightly readjusted for a maximum current in this tank circuit. If desired, the antenna can be coupled to this plate circuit and the apparatus used as a low-power transmitter.



A REAR VIEW OF THE FREQUENCY DOUBLERS AND CRYSTAL OSCILLATORS

The crystal tube is at the right and the three porcelain-based knife switches are used to cut out one or more of the frequency doublers.

The bias on the 210 tube and the 852's is such that when the key is up no excitation voltage is being fed to the grids of these tubes, thus their plate current is practically zero. As the r.f. grid excitation voltage is increased, the plate current increases and this also serves as an indication of optimum adjustment. Thus if we watch the plate current of the 210 tube as the first four condensers are adjusted we find it to be at maximum (the key being down) when they are all in tune. This value, incidentally, will be in the order of 50 milliamperes with the grid and plate voltages indicated.

The plate voltage is now supplied to the 852's. The neutralizing condensers are then adjusted with the key up (no r.f. excitation voltage on the grids of the 852's) until there is no self-oscillation of the tubes when the plate and grid circuits are in tune. The key is then closed and with the thermo-couple meter coupled very loosely to the plate inductance of the last stage, the circuit is adjusted to resonance. The antenna is then coupled and the antenna condensers adjusted for maximum antenna current. Readjustments should then be made throughout the entire circuit in order to secure maximum antenna current.

The antenna employed for these tests was a horizontal half-wave antenna with a 5/4 wavelength feeder, the construction and operation of which has been mentioned.[1] See Fig. 4.

The actual length of the antenna flat-top was 17 feet and the feeder length 42.5 feet. The antenna current with this particular installation was .8 ampere with 500 watts input to the last stage of the amplifier.

To adopt the transmitter for operation with crystals of other fundamental frequencies or in other wave-bands it is merely necessary to eliminate or add frequency doublers as necessary, by switching, choose the proper coils and adjust the condensers.

"Now We're in the Air!"

By Wallace S. Wiggins*

THE title of this story is not intended to refer to a movie of some months ago, but rather to the rapidly growing "air-mindedness" of amateur radio. Taking a brief squint over our glorious past, we see the real "ham" radio, as it really is, taking part in various enterprises of world note, from Greenland's icy shores to the South Pole with Byrd. We've been in the air before, y'understand, but not to such a degree that we could be called members of the air family. We won't forget WNP as a starter for giving the explorer confidence in ham radio. And we remember with a heartache our old friend NERK, the *Shenandoah*. She was the first to give "wings" to the ham. From then on, ham radio began to get acclimated to its angelic element by means of various notable flights, all the way up to KHAB, the *Southern Cross*, which winged its way from Oakland, California, to Australia.

Of course, radio, technically speaking, has been "in the air" for some time, but much of it wasn't ham radio. They've used sets in planes for army and navy tactics for quite a while. Many other civilian installations have been made in planes, but most of them smacked of the "commercial." The others were ham sets from either an engineering standpoint (good ones, we mean!), or they involved the coöperation of the "gang" to such an extent that it was almost strictly a ham undertaking.

The latest stunt by the Knights (for short) of the A. R. R. L., was one in connection with the 1928 National Air Races, at the municipal airport in Los Angeles, from September 8th to 16th inclusive. The Amateur Radio Research Club of the "City of the Angels," affiliated with the A.R.R.L., provided the star performers for the circus, and even though it was a "ground job," it rated as high in importance as any other official function during the races. It was a great success, it gained favor and friends galore, and above all it paved the way for the "bigger and better" chances for amateur radio to continue to prove its worth.

It's about time I told you about the stunt. I am not following the style of the news story, with the important facts in the first paragraph or "lead," for the simple reason that the technicalities involved are familiar to every amateur operator with any experience at all, and because it is the significance of the thing rather than the thing itself that is important.

It started this way. During the air meet, which consisted of the finishes of transcontinental races, army and navy demonstrations of airplane tactics, hundreds of stunts by civilians in planes and 'chutes, a

THE HARD-WORKING CREW FROM THE A.R.R.C. OF LOS ANGELES WHO PUT OVER THE JOB. Left to right: Wm. Breuer, W6BZR; Chas Lundblad, W6CYX; Chas A. Hill, W6BRO-W6DRO; Robt. Parrish, W6QF-W6PS-W6XC; Chas. A. Nichols, W6ASM; Bert Fox, W6DY.

mammoth airplane exposition, and other things too numerous even to remember, there were several local races each day. The races were around five- and ten-mile courses marked by pylons, or steel towers, with checkerboard sides and a "wind sock" flying at the top. Pylon Number 1 was on the field, near the judges' stand. Pylons Numbers 2, 3, and 4 were located at distances of one, two, and three miles from Pylon Number 1. The first three pylons marked the five-mile course, while all pylons were used in the ten-mile course.

Observers were stationed at each pylon. It was their duty to see that contestants did not "cut corners," or take parts of the pylon along with them, or drop souvenirs of the plane along the course, or do a hundred other things they might do and maybe some things nobody had ever thought of before. Then the judges had to know, at any instant, just where any plane was and how many laps it had completed. You've guessed it—reliable communication between pylons and the judges' stand was necessary. Enter our hero, with a vacuum tube in one hand and a key in the other. His pockets are filled with spare parts.

The Junior Chamber of Commerce of Los Angeles had charge of the Committeee on Communications. Our western friend, M. E. McCreery, W6LJ, was on the committee. Whenever something big is happening or

(Continued on Page 60)

*W6CHZ.

Odd Jobs

G. F. Lampkin*

THE job of cutting a circle in a panel requires, for decent results, some sort of a special tool. Certainly the method of drilling and filing around the circumference of the circle is both laborious and productive of indifferent results. For holes from one to ten inches in diameter, in panelling of thicknesses up to one half inch, the device depicted in Figure 1 will give clean-cut results. It was first put together in order to cut an eight-inch by three-eighths inch disc for a sync rectifier as no lathe was available for the job. Later, it was used to cut the circular commutator segments and slip rings from three thirty-seconds inch sheet brass.

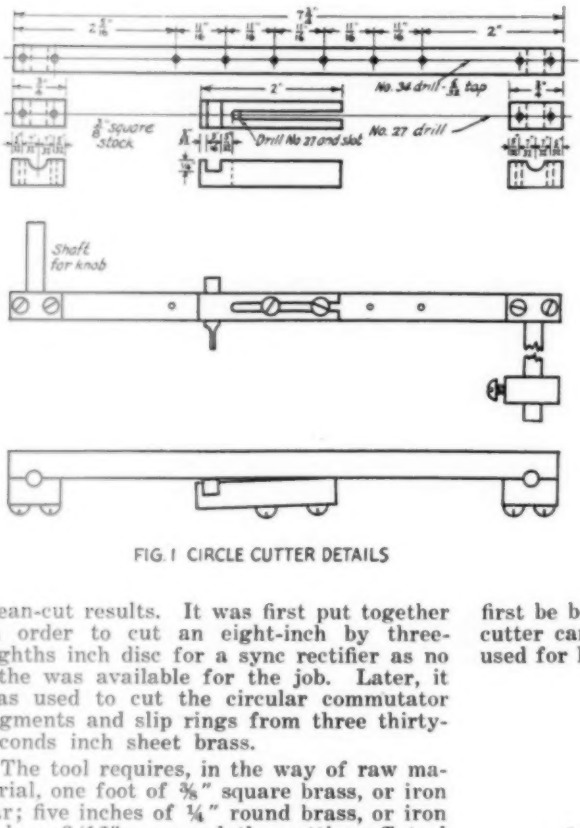


FIG. 1 CIRCLE CUTTER DETAILS

The tool requires, in the way of raw material, one foot of ⅜" square brass, or iron bar; five inches of ¼" round brass, or iron rod; a 3/16" square lathe cutting-off tool and half a dozen 6-32 machine screws. The cutting-off tool may be the hardest item to obtain, though it only costs around a dime. It is a short, approximately three-inch, bar of hardened tool steel, used for making lathe tools. The hardware store should have it or be able to obtain it. Only half the length of the tool will be needed for the circle cutter; any greater length would be in the way. To shorten the tool, clamp it in a heavy vise, half projecting above the jaws, and give the projection a sharp blow. Grind one end of the tool smooth.[1] About ⅜" of the other end should be ground similar to the shape in Fig. 2. The front of the tool is beveled back, to give a raking cut, so that the tool will not grab or chatter. The width of the cutting part is made as small as possible, consistent with strength, for the smaller the cut the less work there will be in making it and the faster will be the job. To prevent the tool from binding on small circles, its outside edge is beveled to the back.

The round central shaft is 3½" long, and the shaft for the knob is 1½" long. Both are clamped under ¾" pieces at each end of the main bar. The holes for these round shafts are bored with a ¼" drill. The two pieces of bar are clamped together, with a piece of cardboard between. Then, when the shafts are inserted, after the removal of the cardboard, they may be clamped down tightly. The ¼" central shaft was used because fairly heavy work was contemplated for the tool. Of course, a ¼" hole must first be bored in the panel before the circle cutter can be used. If the cutter is to be used for light work, and the ¼" hole is objectionable, the central-shaft size may be cut down. The handle used was a glass knob from a drawer pull the likeliest thing at hand.

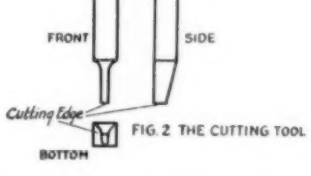


FIG. 2 THE CUTTING TOOL

In cutting, the point of the tool should always ride behind the center line of the two shafts. If a smooth edge to the circle is desired on both sides of the panel, the cut

*3612 Woodbridge Place, Cincinnati, Ohio.

1. A pan of water into which the tool may be dipped occasionally will speed up the grinding process by allowing the heat generated in the tool to be quickly dissipated.—Tech. Ed.

should be taken through about halfway from the one side, and then finished from the other. The work bench, or a box, should be bored for the central shaft of the cutter. The panel should lie perfectly flat on the bench or box. A strip of wood or iron, bored and fitted below the bench and over the lower locknut on the central shaft, can be used handily as a lever to put a slight

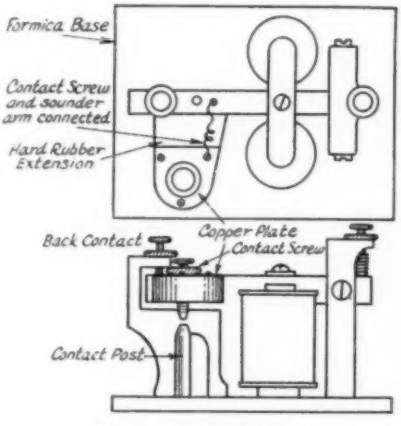


FIG. 3 KEYING RELAY

pressure on the cutting point. Of course some elbow grease is necessary to operate the tool, but even an eight-inch circle can be taken through a panel in a surprisingly short time.

KEYING RELAY

Although making a keying relay from a telegraph sounder is no new job, perhaps a little variety will make another description of such, excusable. The parts of the sounder were removed from the original iron base and remounted, for insulation's sake, on an identically drilled piece of ¼" formica. The hard rubber extension on the sounder arm and the contact posts were added as in Fig. 3. The contact screw in the hard rubber extension was connected to the sounder arm, and the two were used as the blade of a single pole, double-throw switch. The contact post and the back contact were used as the points of the switch. The connections for keying in the plate circuit of the transmitter were made as in the diagram Fig 4. The resistance load was used to keep a current drain on the transmitter plate supply at all times, so that the voltage would not flicker with keying. The regulation of the supply, like that of most transmitter supplies, was very poor, around 30%. The approximate value of the resistance load was calculated from

$$\text{Ohms} = \frac{\text{Plate Volts,}}{\text{Plate Amps}}$$

and this value in wire-wound resistors used. A bit of experimenting should give a water rheostat, or a lamp bank, that would fulfill

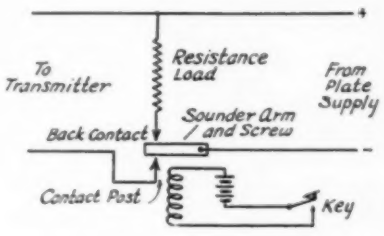


FIG. 4

the purpose. The brass contacts of the relay burned away at a rate of about an eigth of an inch a month, so 3/16" tungsten contacts were obtained[2] and fitted to the relay. After breaking .4 of an amp at 1000 volts for some four months, the tungsten surfaces were still as good as new. If the arc tends to hold after the contacts have opened, condensers should be shunted across the breaks. If possible, the relay should be placed in the negative, or grounded, plate lead. When the sounder arm is connected to the plate circuit, as above, the iron armature on the sounder arm should be kept as far away from the magnets as possible. If the contact screw is used alone, without the resistance load scheme, the hard rubber extension is ample insulation.

AMMETERS

With the half-ampere, radio-frequency ammeters prevalent nowadays for measuring antenna currents, the amateur is sometimes hard put to measure larger radio-frequency currents—for instance, the current in the oscillating circuit of the transmitter, or in the tank circuit of the crystal-oscillator, power amplifier. A shunt of No. 12 tinned bus placed across the terminals of a half-amp Jewell thermo couple meter cut the deflection approximately in half. As this was not enough in some cases, a clip was arranged as in the diagram of Fig. 5. By sliding the clip to the left, the length of the shunt was decreased, while, correspondingly, more wire was added in the meter circuit, so that no matter how large the current flowing in the circuit, the deflection on the meter could be brought to any desired value. No attempt was made at calibration of the meter and shunt, for various clip positions, for only relative readings

2. Tungsten contacts may be obtained from The Kodel Radio Corp., 507 East Pearl Street, Cincinnati, Ohio.

were desired. Such calibration would undoubtedly be useful, however, if the shunt were used extensively on the meter—and providing the clip settings were accurately marked.

STOPPING CONDENSERS

It is a commonly noticed fault of many amateur transmitters that the wave climbs slowly during the first few minutes of transmission—not to mention bona fide wave swinging. At high frequencies the tube

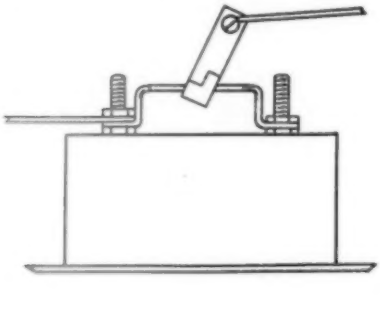


FIG. 5 VARIABLE-SHUNTED R.F. AMMETER

capacities across the helix have appreciable effect on the tuning of the transmitter, and change in the tube capacities, because of heating, or other things, causes wave shifting. When condensers are placed in series the resultant capacity is always less than

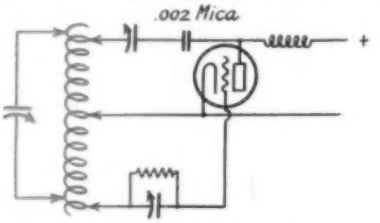


FIG 6 VARIABLE STOPPING CONDENSERS ON TRANSMITTER

that of the smallest condenser in the group. Variable condensers may be placed in the grid and plate leads of a transmitter, instead of the usual .002 mica stopping condensers. These capacities should be made as small as possible without losing an appreciable amount of output from the transmitter. By careful jockeying, they may be cut down to around 100 μμfds. each, depending on the wave band in which the transmitter is used, and a much steadier wave will be had. The grid stopping condenser for even high-powered sets may be a receiving condenser. A receiving condenser in the plate lead will stand up with 800 or 1000 volts on the plate, but a transmitting condenser is needed with higher plate voltages. For the sake of safety in either latter cases the .022 μμfd. mica condenser should be left in the plate lead, so that a direct short would not be had on the plate supply should the variable condenser spark over. Figure 6 gives a schematic transmitter diagram using the variable stopping condensers. The beat note from a 150-watt transmitter, using three ribbon-filament W.E. tubes, would start inaudible at one side of zero beat, pass through zero, and go out on the other side, when keying the set, with the .002 μμfd. condensers in circuit. Replacing these capacities with approximately 100 μμfds. reduced the maximum beat-note shift to 150 or 200 cycles.

Strays

QST with deep regret must report the death at Seattle in middle August of Mr. O. R. Redfern, Supervisor of Radio for the Seventh District. For the last several years a splendid friend of the amateur, his passing must be regretted by all members. With the exception of war-time service as a Lieutenant, U. S. Navy, Mr. Redfern was continuously with the Department of Commerce since October, 1916. Before becoming Supervisor at Seattle he was attached to the Second District office at New York.

The new Supervisor at Seattle is Mr. Edwin W. Lovejoy, well known on the Coast from his long service as a Radio Inspector in the western offices of the Radio Division. In extending A.R.R.L. congratulations on his promotion we must also express our pleasure that the new Supervisor is one who knows and understands us as well as Mr. Lovejoy does.

The paper entitled "Receiver Characteristics and Their Measurements" that appeared on page 23 of the October issue was originally delivered before the Atlantic Division A.R.R.L. Convention held at State College, Pa., on June 15, 1928. We are indebted to that Convention committee for this most excellent paper and our thanks are tendered herewith.

Horace Wilbert, W6EX and the National Radio Tube Company, takes exception to the omission of his rectifier tubes from Ross Hull's mention, on page 28 of the September issue, of a "truly practical" rectifier for 1929 use with high-power tubes. Hull did not mean that a mercury arc was the only rectifier capable of operating a high-power tube, but that for various reasons he believes it most practical. Of course, Hull is a purist in matters radio, and other individual preferences and conditions may dictate the use of some other rectifier such as Rectobulbs, Kenotrons or chemical.

160-Meter Low-Power Transmitter

By George B. Hart*

WHEN the average broadcast amateur becomes interested in two-way communication, he looks with disfavor upon the 1,750-kc. band, because of the fact that he usually thinks that it is necessary to use high power and expensive apparatus if effective results are to be obtained. While he is pondering over a catalogue of expensive transmitting goods, or, as is more likely, building a low power set for use on the already over-crowded high frequencies, he little dreams that a low power, yet efficient, c. w. set may be constructed from receiving parts. Two 201-A tubes are used as the oscillators in this simple full-wave self-rectifying Hartley transmitter. The 110-volt a.c. line is used to supply the plate and filament through suitable transformers. The entire outfit cost me $10.06.

Such a transmitter should especially appeal to men interested in the 1750-kc. (160-meter) code practice and rag chewing, which has recently been inaugurated. It has been used here for several months and in addition to working several locals, stations located as far as 300 miles away have been communicated with. Reports ranged from R4 to R9.

The circuit of the transmitter is shown in Figure 1. The antenna and oscillatory circuits are tuned by 500-μμfd. variable condensers, which in my case were obtained at the local "five and ten." All keying is done in the primary of the plate supply transformer. The 25-watt lamp in series with the power transformer is used to indicate resonance. When the antenna is in resonance with the primary the lamp will burn at about medium brilliancy.

Coils L1 and L2 are wound in the same direction on a 3-inch cardboard tube with No. 18 d.c.c. wire. The coils are spaced ½ inch. Wind the coils as tightly as possible. L1 consists of 25 turns tapped at the 12th turn for the filament return L2 is also wound with 25 turns, but tapped every 5 turns.[1]

The leads should be made as short as possible. The wire may be the usual bus bar such as is used in receiving sets. The entire outfit may be mounted on a 7x12 panel and 10x12 baseboard, or may be mounted in breadboard style without a panel. If a panel is used, the outfit may be placed in a cabinet.

The radio frequency choke consists of 350 turns of No. 30 d.c.c. wire on a 2-inch cardboard tube. The plate power is supplied by two similar 6-1 audio frequency transformers (mine are of the dollar variety) with their primaries in parallel and their secondaries in series.[2]

The filament supply comes from an 8-volt bell-ringing transformer (dollar variety) which delivers 7.6 volts a.c. to the tubes. Those desiring a lower voltage may place a resistance in series with the secondary winding. If old tubes are being used, this extra voltage may help to obtain enough emission.

When the outfit has been completed it will be a simple matter to tune it. Close the

(Continued on Page 66)

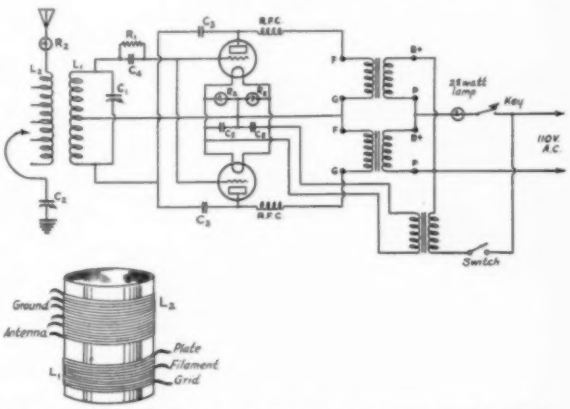


FIG. 1. THE CIRCUIT DIAGRAM OF THE FULL-WAVE SELF-RECTIFIED TRANSMITTER EMPLOYING A PAIR OF 201-A TUBES.

C1, C2—.0005-μfd. variable receiving condensers.
C3, C5—.002-μfd. fixed receiving condensers.
C4—.001-μfd. fixed receiving condenser.
R1—100,000-ohm grid leak (receiving type).
R2—Christmas tree lamps or a center tapped resistor as used across the filament of an a.c. operated receiving tube.
RFC—A winding of No. 30 d.s.c. wire 3 inches long on a 1½ inch tube.

*SDK, 3267 Nash Ave., Cincinnati, Ohio.

1. The most convenient antenna will probably be a grounded one which should be about approximately 120 feet in length. This includes the lead-in and ground lead as well as the horizontal portion.—Tech. Editor.

2. It is possible to get the polarity of one of the secondaries reversed if the markings are not observed or if by chance one of the windings is reversed. This may be checked by listening to the transmitter with the receiver. When the windings are properly poled, the note will be smoother than when one winding is reversed.—Tech. Ed.

Experimenting With Bypass Condensers

By John F. Rider*

IN A recent series of experiments conducted in our laboratory, some very interesting light was thrown upon the subject of detector plate circuit bypass condensers. This information is of utmost importance to the radio fan constructor, who is desirous of obtaining the best quality of reproduction.

The experiments conducted were divided into two groups. In the first group, the objective was to determine how effectively the bypass condenser located in the plate circuit of the detector tube, across the coupling unit, from the plate of the detector tube to the negative filament circuit, bypassed the radio frequency component remaining after rectification. In the second group, the objective was to determine the effect of various values of bypassing capacity upon the audio frequency signal remaining after the process of rectification has been completed.

Every radio fan realizes the need for a bypass condenser in the detector plate circuit, connected as mentioned in the previous paragraph, across the first coupling unit primary circuit. But, apparently, every one does not agree upon the correct capacity; values ranging from .00025 μfd. to .006 μfd. being recommended. The figures ascertained in this series of tests will no doubt be of interest to the constructively inclined class of radio fans.

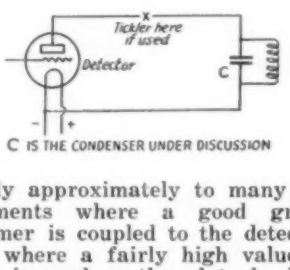
In view of the fact that the greatest interest is devoted to the audio frequency response, the experiments pertaining to the audio frequency signal bypassing were conducted first. The bypass capacities under test ranged from .0005 μfd., to .006 μfd. The method of testing was as follows: An audio signal of known frequency was passed into a vacuum tube to which was coupled an audio frequency transformer with a high primary inductance. The bypassing capacity was connected across the primary inductance, from the plate of the tube to the negative filament. The output circuit of the audio frequency transformer was connected to a calibrated cathode ray oscillograph tube; that is, the deflections on the screen are calibrated in volts. With uniform input on the various audio frequencies and known values of bypass capacity, the variance in the output as shown on the oscillograph screen, when different values of bypassing capacity are used, is indicative of the bypassing of the audio frequency through the condenser.

*Aervox Wireless Corp., 70 Washington St., Brooklyn, N. Y.

The frequencies considered were 3,000, 4,000 and 5,000 cycles. The following figures the various condensers, expressed in the form of a fraction of the original tube output:

	3000 cycles Percent	4000 cycles Percent	5000 cycles Percent
.0005 μfd.	.05	.05	1.75
.001 "	3.00	4.00	6.00
.002 "	8.00	11.80	12.40
.003 "	11.00	14.00	16.40
.004 "	14.00	17.00	20.00
.005 "	16.00	20.75	26.00
.006 "	19.00	23.50	31.00

The disadvantages accruing through the use of excessively large bypass capacities in the position mentioned are very evident in the table. For example, the .006 μfd. condenser bypasses 31 per cent of the total output of the tube on 5000 cycles; 23.50 per cent on 4000 cycles and 19 per cent on 3000 cycles. The .0005 μfd. condenser on the other hand bypasses only 1.75 per cent on 5000 cycles; 5 per cent on 4000 cycles and .05 per cent on 3000 cycles. The figures shown apply to the specific case mentioned,



C IS THE CONDENSER UNDER DISCUSSION

but apply approximately to many similar arrangements where a good grade of transformer is coupled to the detector circuit, or where a fairly high value of inductance is used as the plate load in the detector circuit. Summarizing, we find that as far as audio frequency signals are concerned, the bypassing capacity in the detector plate circuit should never be more than .0005 μfd. or at the highest .002 μfd. A .0005 μfd. is preferable, however.

The selection of the bypass condenser does not rest solely upon audio frequency considerations. It is also necessary to determine how effectively the bypass condenser will bypass all radio frequency signals remaining in the circuit after rectification. It is essential that the radio frequency component in the detector plate circuit remaining after rectification be bypassed to the negative filament, and so kept out of the audio circuits. If a certain value of bypass condenser will bypass the correct amount of radio frequency current in the detector plate circuit, and at the

(Continued on Page 58)

Experimenters' Section Report

IN the past, these columns have been devoted to the use of the members of this Section only. It is believed that there are many, who though they may not have enough time at their disposal to warrant their taking part in the general program, have time for short experiments that result in interesting information of value to the rest of us. In many cases these men feel that the results of small experiments are not important enough for separate presentation in the form of short articles nor that their results may be written in condensed enough form to allow of their use as "strays". The result is that such information remains unknown to the rest as far as that particular incident is concerned. We, therefore, feel that in justice to all, these columns should be opened to all experimenters regardless of whether or not they are definitely engaged in working out the answer to those problems presented to the members of the Section.

We are also aware of the tendency on the part of various members to refrain from reporting the results of their experiments, chiefly because they feel that the experiment is not complete in that the entire answer to the outlined problem has not been obtained. Unfortunately, very few of us have the equipment and time to completely cover and solve the major problems listed and the result of this reasoning appears in what apparently seems to be lack of interest in the problem. We know that such is not the case and if you are working on a problem and find that although the entire answer may not be at hand that you have uncovered information of interest let us know about it so that it may be reported in *QST*. In this fashion others who may be working on the same problem will have the benefit of your findings and the time necessary to obtain the answer to the problem as a whole materially shortened.

If you have run across some interesting subject that requires further investigation or if you have learned of a new use for some old equipment or if you have found a new kink which will help the other experimenters along, write in and let us know of it so that others may get some benefit from your work. Information that is not distributed among those to whom it will be of value is certainly not being used efficiently.

SPECIAL PROBLEM 66

This problem concerns the electrolytic rectifier and has been held in abeyance many months due to various reasons. The Aluminum Company of America has been kind enough to supply us with a limited number of aluminum electrodes to be used in the construction of electrolytic rectifiers. Due to various reasons some of those who were originally interested in taking part in these experiments are now unable to do so and we can enroll a limited number of additional men in this problem.

We are particularly interested in enrolling men who do a considerable amount of operating so that the rectifier will be

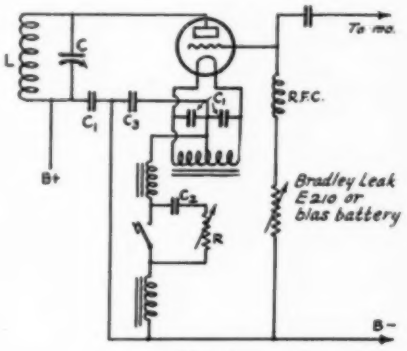


FIG. 1

L, C, C1 and r.f.c. are of usual values.
C2—.5 μfds.
C3—.005 μfds.
R—300-ohm potentiometer.
Chokes are of the dollar store variety, used for "R" substitutes. About 30 henries and 85 mils. capacity.

in operation as many hours per month as possible. The aluminum for the rectifiers will be supplied through the courtesy of the Aluminum Company of America while the lead electrodes and the chemicals are to be obtained locally. Two types of electrolytes will be employed in each rectifier; one half of the jars will use a borax solution and the rest will use a solution of ammonium phosphate. A monthly report covering the action of the rectifier must be made up and submitted so that the performance can be charted. It is absolutely necessary that the drain on the rectifier and the voltage being rectified remain substantially constant throughout the length of the test as any considerable changes in these values would render the results worthless. If you are in a position to run a satisfactory test upon such a rectifier and have the time to fill out and return to us the report blanks which will be sent you each month we would be pleased to hear from you. In your letter give a brief description of the transmitter you are using, telling the type of

tube employed, the plate voltage and plate current together with an estimate of the approximate number of hours the transmitter is in operation each week. A plate milliammeter is essential in order that one may know the amount of current being rectified. It is not necessary that a plate voltmeter be available although this is desirable.

If you have used chemical rectifiers in the past, give a brief outline of their construction and the amount of success had with them. Also state the number of jars to be used so that the correct number of electrodes will be supplied.

BARCLAY CHARTS

Some time ago we distributed a number of Inductance-Capacity-Wavelength charts which were supplied by Mr. R. H. Barclay. For some time after our supply of these was exhausted we received requests for them. We were under the impression that the supply had been completely exhausted but we have recently received about 500 additional copies which Mr. Barclay ran across. If those of you who were disappointed in the past will drop us a card, we shall be pleased to mail a copy of this chart to you. A word of thanks to Mr. Barclay, c/o Stone & Webster, 49 Federal St., Boston, Mass., in appreciation would not be amiss.

KEYING

H. M. Walleze has supplied the following suggestions for keying the amplifier of a mo-pa set. He states that with this system W8WJ and W8BQ who are less than three blocks apart can work within a few kilocycles of each other without the least sign of key thump.

The by-pass condenser may be of almost any capacity and the chokes will stand quite a wide variation without affecting the results materially.

R. F. CHOKES

Clyde C. Anderson of W7JF and K7AD brings to our attention once more the use of the tunable radio frequency choke. The idea is to make a rigging so that a ring of copper or brass which is connected to the plate supply side of the choke may be adjusted along the length of the choke. A Neon lamp may be run along the choke and the ring adjusted so that there is no r.f. at the plate supply end of the choke. Such chokes may be used over a wide band of frequencies and the position of the ring may be marked and thus returned to the proper position when the set is being adjusted to a new frequency.

REPORTS

Don't forget to let us have reports on your work as soon as you have arrived at some information that is of interest to all. In this way others will obtain some benefit from your work which probably would not be obtained if one waits until the complete answer to the entire problem has been arrived at. It is the object of these reports to keep others interested in the same problem in contact with the work that is being done so that the least amount of waste effort will be used.

—*H. P. W.*

The Northwestern Division Convention

HOTEL BERGONIAN *actually accommodated* the enthusiastic bunch of hams who gathered there from the Northwestern and Pacific Divisions on August 31st. After registration was finished the program commenced with an informal luncheon. At this, talks were given by prominent amateurs.

The afternoon was spent touring the Seattle *Times* press plant and W7FD, W7TX, W7LZ, W7ACB, W7AEV and W7HO, incidentally taking in a lot of Seattle's "pine mast" scenery along the way.

In the evening a technical meeting was held at the Bergonian. Lieutenants Street and Burleigh of the Naval Reserve, and Louie Huber of A.R.R.L. headquarters gave short talks. Then Dave Sloan took the chalk in hand for the next five hours, explaining antennas, transmitting circuits, feed systems, and—well, was there anything he had not explained by one o'clock the next morning?

The undersized Leviathan that John Waskey chartered for the trip on Puget Sound *did not sink* (it's a wonder) when the gang trod up the plank Saturday morning. Our first port of call was NPC, the Naval Radio Station at Keyport. Chief Radioman Thomas had the transmitter all shined up for us, and gave out blown 500-watt tubes for souvenirs. The large number of V's sent from NPC's high frequency set that morning were occasioned by the enthusiastic group of admirers whose proximity detuned it!! Nobody got seasick on the return to Seattle, even though we did collide with a drifting plank.

The banquet, of course, was the best of all. Seattle's two YL's, Doroles (W7OH) and Louise (W7AEV-AGA), sang some songs for us. With Waskey as toastmaster, the gang heard from 'most everyone. Acting Supervisor of Radio, Clark was there, and His Majesty, J. King Cavalsky, represented the Vancouver bunch, who were there in goodly numbers. For the rest of the evening (and next morning) the brass was pounded *clear flat* at local ham stations.

—*L. R. H.*

Another Way of Playing an Old Prank

By Rufus P. Turner*

IT APPEARS that the practice of connecting a microphone in with one of the audio frequency stages of one's radio receiver, and speaking into that instrument so that the voice issues forth from the loudspeaker, has become almost universal at radio parties. The stunt came into vogue somewhat less than a year ago, subsequent to the appearance of a magazine article which depicted the amusement afforded a group of callers when one amateur incorporated an ordinary telephone microphone in the circuit of his receiver, and made his guests believe they were listening to broadcasting from the Antipodes.

The microphone had easily been included in the primary of one of the audio frequency transformers, having previously been connected with a concealed pair of wires extending from the room, some distance down the hall, in which it was located. Between selections, one confederate obligingly opened the outdoor antenna switch, in order that the real announcer would not be heard, while the second confederate announced some Australian station.

The writer recalls a perfect enaction of the prank at a radio party, where both the confederates were equipped with small, portable receivers in order that they might know exactly when the antenna switch was to come open and the fake announcement made. Also, confederate number two, who had charge of the microphone, knew precisely what selection was to follow and made his announcement accordingly.

The guests, grouped before the loudspeaker, were amazed, to say the least, upon learning so unceremoniously that their host's radio receiver could "pick up programs from across the seas." Not one of them suspected the whole affair to be a practical joke, so nobody consulted a newspaper to see if the program was not being broadcast by one of the local stations.

The affair was such a success that the writer determined to "pull off the stunt" at a coming meeting of other radio men at his amateur station. But the fact presented itself that radio men couldn't be fooled by the microphone prank. They would surely examine the set, discovering the wires connected at the other end to the remotely located microphone.

The difficulty was soon overcome when the writer hit upon the idea of connecting the microphone with the receiver, not directly, but through the medium of inductive coupling. The concealed wires connecting with the distant microphone were made to terminate in a loop of a few turns. (The number of turns and the proper diameter, it was found, vary with the type of radio set and both must be determined by experiment.) The loop was made of number twenty-two cotton-covered wire, and was carefully placed beneath the cloth cover, upon the table that held the set, in such a way that inductive relation was established between the turns of the coils of the receiver and the turns of the loop.

The loop is similar in performance to that employed by transmitting amateurs in the so-called "loop modulation." It is only necessary to turn on the receiver and, when the loop and one of the coils in the receiver are in inductive relation, speak into the microphone. When the coils of the set and the loop are near enough to each other and the wires connecting the loop and microphone are not too long, the results are quite pleasing. The writer has met with success both with regenerative and radio frequency broadcast receivers.

The prank went over big at the writer's party, providing no little entertainment. The guests, all radio men, searched the set for telltale wires, without success, and appeared quite *non compos mentis* when the secret was subsequently revealed.

*604 East 51st St., Chicago.

Strays

The O. W. says she can't see why they call them short waves unless it's because there aren't enough to go around.

Dr. Lawrence J. Dunn, Director of the Hudson Division, announces the dates for the Hudson Division A.R.R.L. meetings of the 1928-29 winter season. The dates fall on the first Monday of each month: October 8th, November 5th, December 3d, January 7th, February 4th, March 4th and April 1st. The meetings are held at the Army Building, 39 Whitehall St., New York City, with room for about 300. Interesting programs, with technical talks and discussions of amateur problems, will be provided. There is no charge whatsoever. Members and their friends are invited.

The Y. L. thinks that all political speeches should be broadcast on short waves only—the shorter the better.

Some Radio Uses of Lamp Banks

By I. Vee Iversen*

HERE are a few uses for a lamp bank. These things are really handy to have around. I have just completed a master oscillator outfit and in it have found the use of lamp banks a great help. To start with, I am using W.E. oxide-filament tubes, in which the filaments must be kept warm even when not transmitting.

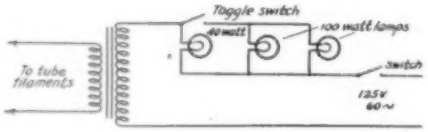


FIG 1

A lamp bank solves this nicely as shown in Fig. 1. I use one 40- and one 100-watt lamp in the primary of the filament transformer. These take care of the VT-2 and the WE211-D. For a VT-2 and a UV-203, it is necessary to use one 40-watt and two 100-watt lamps to give the rated voltage

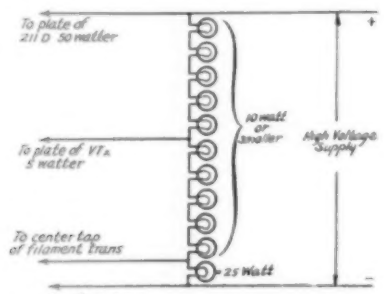

To plate of 211 D 50 watter
To plate of VT2 5 watter
To center tap of filament trans
Negative C supply for the 50 watter
10 watt or smaller
High Voltage Supply
25 Watt
+
-

FIG 2

on the tubes. When I give the "ga" to the other fellow, throwing this toggle cuts the filament voltage in half but keeps the tubes hot.

As you know, the VT-2 will not take the same plate voltage as the 50 watter. Figure 2 shows my way of getting around that. I have a bank of 12 lamps (in series) across the plate supply. Eleven of these lamps are rated at 10 watts and 1 at 25 watts. The voltage drop across the 25-watt lamp is the negative grid bias on the 50-watt amplifier. This eliminates the purchasing of batteries for this purpose and the voltage drop across 6 of the 10-watt lamps gives me the voltage for the VT-2 plate.

By changing the size of the lamp supplying C-bias the value of bias may be changed. With a 25-watt lamp and the VT-2 drawing 40 mills and the 211-D drawing 160 mills, the drop across these lamps is about 105 or 110 volts, which makes the set work satisfactorily. To my notion, the use of lamp banks should be increased. Since I have gotten used to using lamp banks a new use suggests itself almost every day. For a fellow using a mercury arc for power supply, the above will furnish an admirable keep alive load besides the other uses and at the same time makes a good fuse—on excessive plate currents the C-bias lamp will go west. The C-voltage then goes up, blocks the plate current and saves the tube.

*7AW, 6554 18th Ave., N. W., Seattle, Wash.

Standard Frequency Transmissions of WWV

THE Bureau of Standards announces a new schedule of radio signals of standard frequencies for use by the public in calibrating frequency standards and transmitting and receiving apparatus. This schedule includes many of the border frequencies between services as set forth in the allocation of the International Radio Convention of Washington which goes into effect January 1, 1929. The signals are transmitted from the Bureau's station WWV, Washington, D. C. They can be heard and utilized by stations equipped for continuous wave reception within a radius of 500 or 1,000 miles from the transmitting station.

The transmissions are by continuous wave radio telegraphy. The signals have a slight modulation of high pitch which aids in their identification. A complete frequency transmission includes a "general call", and "standard frequency" signal, and "announcements". The "general call" is given at the beginning of the eight-minute period and continues for about two minutes. This includes a statement of the frequency. The "standard frequency signal" is a series of very long dashes with the call letters (WWV) intervening. This signal continues for about four minutes. The "announcements" are on the same frequency as the "standard frequency signal" just transmitted and contain a statement of the frequency. An announcement of the next fre-

(Continued on Page 58)

Calls Heard

G. A. Parslow, 27 Eastbourne Road, Tooting Junction, London, S.W. 17, England.

wlack wlabx wlalb wlano wlap wlbfz wlbyv wlbwl wlcki wlcj wldv wlfs wlky wlnv wlnx wlsf wlsz wlzl w2aog w2ail w2arb w2avb w2bac w2bcc w2bvg w2cum w2cu w2cxl w2cvj w2djv w2ky w2nm w2rs w2rx w2tp w2vi w2vk w3ac w3abc w3adm w3jn w3nr w3wm w4adm w4agf w4aq w8agy w8awf w8ax w8axa w8cfr w8cug w8duw sb-laak sb-law sb-2az sb-lat sb-2ig sb-law sc-3cj wnp ve2ap ve2bg.

Alan G. Brown,.8 Mangarra Road, Canterbury, E7, Victoria, Australia.

wlaao wlasf wlbux w2cxl w2kl w2tp w3afj w3cgf w3hh w3lw w4aau w4dt w5aej w5afx w5agc w5apc w5ayo w5ba w5bcm w5bf w5bj w5hn w5pa w5rg w5qa w5ql w5qx w6abg w6abk w6ags w6ahx w6akk w6aoe w6aos w6ap w6apf w6ask w6aur w6awe w6ax w6bco w6bf w6bfo w6bhz w6bjf w6bjx w6boy w6bvy w6bws w6bxi w6bzs w6caj w6chr w6aih w6cuh w6cut w6dca w6dgo w6djq w6dlx w6dpo w6dpw w6dq w6dtd w6dto w6dzj w6eaa w6eah w6eba w6ecg w6edx w6eeo w6efj w6egx w6eha w6wn w7ac w7bad w7cm w7dm w7gj w7gk w7si w7vx w7xb w8afb w8cau w8enz w8dca w8tn w9apa w9bcn w9bmw w9cjh w9cks w9dbw w9efe w9egm w9ekc w9emr w9epa w9ewm w9fdj w9fgj w9gv w9hd w9hn w9pu wwel xnu-lg nux-md ac-lpp ac-2mo ac-7sw ac-8ag ac-9aa ag-67ra ai-2kw aj-jxix aj-law aj-3ww aj-4zz aj-7cb aj-7mf ea-hg eb-4ar eb-4us ec-2un ee-ear28 ef-8fr ef-8axq ef-8orm ei-1eh ei-1go ei-1po ek-4aar ek-4yt em-smuk ep-lae ep-lae ep-3ap xep-1ma fq-ocdl fg-octu fq-ocya k7aer k7als k7sc wweg ve3fc ve4cu ve5co ve5aa ve9ap nn-1nic nn-7nic nzfr5 oc-8xz od-1ao od-1jr oa-1wa od-1xm od-4as oe-hvw k6akg k6boe k6bqh k6ch k6dpg k6dsd k6dvg k6ecc k6xk k6dqq op-1ad op-1cm op-1gw op-1hr op-1pw sb-1av.

ec-RP10, Miss M. Benesova, Prague-Smichov, Plzenska str. 32, Czechoslovakia.

wlbqs w2rs w2uo w8rau ne-8ae sb-1ak sb-1ca sb-2aa sb-2ab sc-3ac su-1oa su-2ak fe-egez fm-8rit fo-a3a ag-1eq ag-14rb ai-2kt ai-2kw am-3ab aq-11m oa-2lg oa-3ls oa-5hg oa-7cw oa-2ay ea-aa eb-4au eb-4cc eb-o4di eb-4ft eb-4gm eb-4us eb-4yl ec-1ab ec-1kx ec-1mx ec-1na ec-1rv ec-1yl ec-2un ed-7md ee-ear6 ef-8ct ef-8dmb ef-8ez ef-8gdb ef-8mmp ef-8orm ef-8pns ef-8psc ef-8sta g6iy g2nm g6wn ei-1ah ei-1eq ej-1fb ei-1fe ei-1mt ei-1mw ei-1pn ek-4au ek-4hf el-1al em-smuk em-hmzf en-odj en-ofp en-ojm en-oyy eo-1iz ep-1aa ep-1bl ep-1bx ep-1ct xep-1ma es-2nag et-tpar et-tpkx et-tpao eu-13rb ew-be ew-wy.

G2BOQ, H. E. Bottle, 27 Stormont Rd., London, S. W. 11, England

wlaca wlaod wlaof wlbcv wlbcy wlbea wlbkf wlbkh wlbqs wlbqv wlbyh wlcjc wlcmd wlcra wldv wlgy wljg wlmr wlqh wltl wlwv w2adj w2aep w2agn w2ail w2aog w2ary w2avb w2avz w2azu w2bac w2bcw w2bjs w2bm w2efk w2ehd w2cmu w2com w2cuq w2lx w2nf w2rs w2rz w2uk w2vi w3aok w3ava w3awq w3bm w3cdk w3ahk w3ke w3tr w4aba w4acv w8acm w8awf w8bjb w8cau w8cnz w8dcq w8dtn w9anq w9fci w9mt velbr ve2bg nq-2kp nq-2jj nz-fr5 sa-az2 sb-2ar sc-1ni fo-a3z wnp.

A. Comender, Burg, Meinesrlaan, 91B, Rotterdam, Holland.

wlaei wlka wlalb wlapi wlia wlbyv wlcaa wlaeh wliy wlahx wlaia w2uo w2com w2gv w2kl w2cxl w2inb w2avb w2aeu w2bo w2nf w2arb w2atr w2dg w2rs w3bqv w3ge w3aih w3wj w3cdk w3anh w3auj w3jn w4ft w4acx w4agr w4acv w4aej w4vc w4oh w4js w8cx w8axa w9cia w9cax ve2br ve2ca ve4bt ve9ap k4agf nq-5fl nj-2pa ag-skwg ag-6grb ag-rbl4 ag-rb64 ag-1mdz as-15rw as-15ra ff-8pj fq-8hpg fm-tun2 oz-2aw sa-de3 sb-1ca sb-1bo sb-1id sb-1ah sb-1be sb-1cj sb-1aw sb-1af sb-1bs sb-2bg sb-2af sb-2al sb-2aj ab-2ah ab-2ay sb-6qa sc-2ab sg-a7 su-2ak xnu-7eff xnu-7ef xep-1ms xef-8gcr xed-7gb.

ef-RO91, C. Conte, 24 Allee du Rocher, Clichy-sous Bois, (S. et. O) France

wlabd wlack wlafb wlafl wlagw wlajx wlaqp wlaqt wlasd wlaxx wlayt wlbbt wlbgq wlcmf wlcpc wlcrs wlgx wlim wliy wlkb wllc wlsr wlasp wlahz wlcnz w2ajb w2alu w2ang w2api w2aql w2atc w2baj w2baz w2bbl w2bek w2brh w2blc w2blx w2bm w2bmx w2bsm w2cbk w2cin w2ckq w2com w2cuq w2cxl w2dr w2dl w2fa w2gj w2jd w2rs w2ti w3aic w3amx w3anh w3apn w3ard w3avl w3cgf w3chg w3ckl w3ec w3ga w3tr w4aam w4aau w4aay w4abl w4acz w4ado w4ahy w4aq w4ca w4fe w4fi w4hz w4lc w4nu w4rj w4th w4vl w5apo w5ark w8adg w8adu w8agy w8agq w8aht w8air w8aso w8awp w8aze w8baz w8bm w8box w8bpl w8brl w8bvg w8cft w8cfh w8cnr w8cnz w8chr w8csv w8cvj w8did w8dnf w8duw w8rh w8avz w8bja w8dcm w8dpz w8dsy w9ara w9auh w9crd w9cya w9cue w9eln w9enr w9ewh w9fqs w9mn w9bqc ngm velbr ve3gl nq-2yt nq-2xc.

ec-RP 19, Alois Weirauch, Mestec Kralove 9, Czechoslovakia.

wlbux wlnp wlrf w2apv w2ass w2bjg w2bm w3anh w3aob w3apx w3bms w4dt w8aau w8box w8duw w9abv w9crd nj-2pa nn-7nic np-4ug nt-2fp nq-5fl nq-7cx nx-1ah nz-fr5 fq-pm fq-8hpg fq-8rya oa-3vp sa-de3 sb-1ah sb-1ai sb-1bs sb-1ca sb-1cg sb-1cj sb-1id sb-2ar sb-2ay sb-5af sc-3cj sg-a7 su-1cd su-2ak sb-1bm (20 meters)
wlarq wlawe wlbyv wlcmf wlfs wlsz w2adm w2api w2azo w2cxl w2vi w3adm w3edk w8axa nc-1ap nc-2ca ne-8ae ne-8wg fq-8hpg oa-5gh sb-1aw wnp.

ed-7XX, H. Glistrup, Copenhagen, Denmark.

wlage wlaqt wlbux wlby wlbyv wlcmf wlfs wlry wlxm w2agn w2api w2arb w2avb w2avx w2bcc w2bfq w2cmu w2kx w2lx w2nm w4act w9adn w9bqy w9ef vc2bg ve2by ve-2ca sa-2az sb-1at sc-1aw sc-2aj sc-2ig sc-1lt su-1na fg-ocya.

(Continued on Page 59)

Conducted by A. L. Budlong

THERE has been a gratifying response to the request that National Sections appoint official I.A.R.U. correspondents, and see to it that regular reports on amateur activity are sent in to this department for publication. Due to the cumulative lags of distance and the month-and-a-half-in-advance publication factor, it will be several months before several new countries become regularly represented here, but the point is that they will be here.

We want to make this a department where, each month, you can be sure of finding the latest advices on changes in legislation or regulations in other countries of the world, future plans and policies of the individual national amateur organizations, and amateur happenings. The coöperation of every national section is necessary in order to accomplish this. Please do your part.

DR. CURT LAMM, EK4CL, VISITS HEADQUARTERS

It was a great pleasure, on September 27, to welcome to A.R.R.L. Headquarters, Dr. Curt Lamm, a member of the Executive Headquarters of the D.A.S.D., the German amateur society, a prominent amateur, and the operator and owner of ek4CL. Dr. Lamm is in this country for six months to conduct chemical research work at Cornell University, and hopes at the same time to become thoroughly acquainted with American amateur methods.

His visit to Hartford is greatly appreciated, for the Doctor has to report to Cornell the first of October, and Hartford is not on the way to Cornell.

During the day we looked over the Headquarters office, talked about the I.A.R.U., and cleared up many points which had been hazy in this editor's mind regarding the National Section in Germany.

That evening a dinner was held at a local hotel at which we had Dr. Lamm, Mr. Maxim, Col. Foster, W6HM, Marshall Wilder, of Boston, and the Headquarters Staff of the A.R.R.L. It was a most informal and pleasant evening, and will be remembered by all of us for some time to come. After the dinner there were short speeches by Mr. Maxim and Col. Foster, and a most gracious one by Dr. Lamm. Following this, the affair turned into a thoroughly delightful hamfest. About 10:30 P.M. everyone adjourned to the main dining room of the hotel for coffee and sandwiches, and the hamfest was resumed, to be continued until the management closed up the place at midnight.

We hope Dr. Lamm has a pleasant stay in this country, that he will have time to attend some conventions, and that he will make many NU QSOs. This last fact seems assured, since the Doctor has expressed the intention of taking out an operator's license and getting on the air as soon as possible. For the benefit of American hams, we might say that Dr. Lamm speaks excellent English, that he can receive up to thirty words a minute, and that his sending (as we heard it at 2ALU's the night ek4CL landed) sounds like machine sending at twenty-five words a minute—with a straight key, too!

FRANCE

In a recent issue we chronicled the fact that an election had been held in the Reseau Emetteurs Francais, and listed the name of the new president. Mr. Robert Audureau has now supplied us with the names of all the new officers, which are as follows:

President: J. Reyt, 8FD.

Vice-Presidents: R. Desgrouas, 8LH; J. Bastide, 8JD.

Secretaries: R. Audureau, 8CA; R. Martin, 8DI.

Treasurer: R. Larcher, RO1O.

Honorary Presidents: Leon Deloy, 8AB; Pierre Louis, 8BF.

President-Founder: Jack Lefebvre, 8GL.

Mr. Audureau also advises us that the only address to which communications for the R.E.F. should be addressed is:

Larcher, B. P. 11, Boulogne-Billancourt, Seine, France.

We offer our sincere congratulations to the new officers of the French section. The R.E.F. now has more than 800 members, indicating a steady and healthy growth. This is splendid.

GREAT BRITAIN

Great Britain is one of the countries maintaining an official correspondent for this department, and it is a source of much gratification to receive a report each month. The latest one follows:

"What with holidays, dud conditions and fine weather resulting in QRM from cricket and tennis, there does not seem to have been very much DX done during August. Certainly conditions were pretty bad; as 2XV put it, fancy wanting a DX report when first district Yanks, even, are rare as roses in January! 2XV, however, is running a schedule with oa7CH on 23 meters. 2NH, too, worked OA every morning for a month on that band. 2CX keeps a sked with oa5HG and also raised several NUs, including a nine.

"5BZ raised the first, second, third and eighth districts, NC, OZ, OA and SB and needs only to get an Asian station for his WAC, wherefore he finds life good. 5BY says ND, with only about three dozen Yanks, SB and SA. If that's ND, OM, let's have a real report. Hi! 5YK worked SU on 23, but is very busy with ten-meter work. 6SM hooked fk4MS. 2AX moans about conditions, but worked two or three. 5ML worked the U.S., but not much else. 6CI exercised his Morse on the long-wave commercials. FB OM! Hi! 6BY worked some NU's SB and SC.

"6BB worked sc3AC with 4 watts on 23 and NU 6, NC 5 and OA with 8 watts. Good work, OM, and more like the old 20-meter stuff. 5LS ran a nightly sked with NU while un1II was at his shack. 5BQ found things good on 45 and worked several nines. 5YU had a stab on that band, too. Long waves these days, OM's! Several hams have had the pleasure of meeting nu1II, both at their shacks and also at the keys of some of those he visited. nu6BJH also called on 5BZ and 5BY, to their great pleasure."

NORTHERN IRELAND

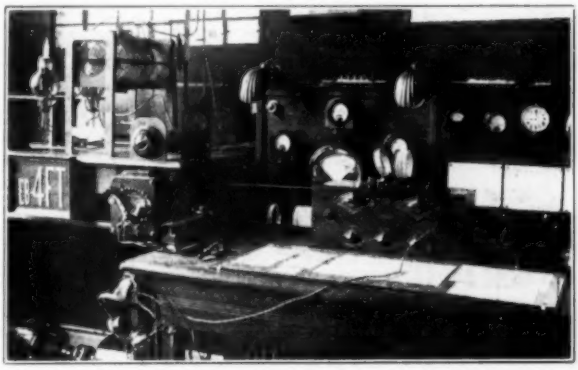
With this report, the series of interesting articles contributed to this department by Mr. Megaw will come to a close. Mr. Megaw is leaving Ireland to conduct research work in London for two years. We congratulate him most heartily on this appointment, but at the same time we regret very much that his good fortune deprives us of such a satisfactory correspondent. We hope that the R.T.U. will immediately appoint some one to take up the work which Mr. Megaw must now leave to other hands. The report follows, and contains a most interesting resume of amateur progress in Northern Ireland:

"As this is the last time these notes will be penned by the present writer, perhaps a few words in retrospect will not be out of place.

"It is now something over three years since the first amateur transmitting licenses were issued in Ireland. At that time, there came into being a few isolated transmitters, all using very low power and operating under somewhat irksome restrictions, and this represented the result of several years of effort on the part of some of those amateurs. (It will be remembered that the unsettled political state of the country was the cause of this prolonged delay.)

"After about a year, the numbers had increased sufficiently to warrant the formation, in September, 1926, of the Radio Transmitters' Union (Northern Ireland), an organization which is run on rather unusual lines and which has been a great success and a considerable factor in the development of amateur radio in this province during the last two years. It now enjoys the recognition of the Post Office and broadcasting authorities. Its membership includes almost all the transmitting amateurs in Northern Ireland and membership of the

(*Continued on page 54*)



AMATEUR STATION cb4FT, OWNED AND OPERATED BY GEORGE NEELEMANS, TRAFFIC MANAGER OF THE RESEAU BELGA AT BRUSSELS, BELGIUM, is one of the most widely known amateur stations in the world. The circuits is a Mesny, with two 150-watt Mullard valves. An Esco motor generator supplies 1100 volts for them. The antenna is a half-wave Zeppelin working on 32 meters. All instruments are Westons, and the receiver is a Grebe CR-18. These, with the Esco m. g. and the Vibroplex key cb4FT, to use the words of its owner "rather a Yank station in appearance"!

Correspondence

The Publishers of QST assume no responsibility for statements made herein by correspondents.

Our New Calls

Box 698,
Pampa, Texas

Editor, *QST*:

I notice some of the gang are already having their cards printed in this manner: w5NW or W-5NW.

If I understand this new call business correctly they should be printed in this manner: W5NW. In other words, all U.S.A. calls start with the letter W instead of a numeral as theretofore. And the W is as much a part of the call as the numeral and the rest of the letters, and should be given as much prominence on the QSL card. In calling I notice some do not use the letter W every time they send their call. A call should be made in the following way: CQ CQ CQ de W5NW W5NW W5NW.

—Wayland M. Grove, W5NW

Editor's Note: Mr. Groves is dead right. Just as commercial stations have calls beginning with W or K, like WIZ and KWE, so do amateur calls now begin with these letters, like W5NW and K6CFQ. Similarly in other countries where calls are being changed, like G2NM, GI6MU, VE1AR, ZL2AC—the initial letter or letters are part of the call, not to be separated, and to be printed in caps. See our October editorial on this subject. We recommend, however, that for calling purposes we use the old "international intermediate" until such time as governments change their amateur calls, and that in written references to such calls we use lower-case letters, thus: ef8HIP, fqPM—to avoid confusion with calls legitimately beginning with those letters.

The Extra First Grade

2631 Garfield St. N. W.,
Washington, D. C.

Editor, *QST*:

Your editorial on the amateur extra first grade license, in the September issue, was read with great interest by myself, and, I know, many other "hams". I feel, as you have said that we never really appreciated this class of license until it was taken from us.

It may interest you to know that, having read your editorial, I decided to take time by the forelock, and accordingly, was issued yesterday amateur extra first class license number one of the new series. Now that the ball has been started rolling, here's hoping more amateurs will take out this license.

—Willard R. Burton, 3NR

Undelivered Messages

Uxbridge, Mass.

Editor, *QST*:

On September 14 and 15 the Blackstone Valley Radio Association held a booth at the Uxbridge Fair and accepted messages from the patrons of the Fair. At the end we had 138 messages both 1COS at his station in Milford and 1BZJ operating the Assn's station 1JB were at the key for two days getting off the messages of the hook, some stations they QSO reported them R7 good note very steady but when asked to take traffic all they say was, "lot QRM or QRN gld to QSO u OM, 73," and they would go for somebody else without waiting for any reply from our stations. According to the reports made by some patrons only about 50% of the messages that were sent from our station were ever delivered to the addressee. I think that this is a very low mark, and that it gives our organization a bad name from those whose messages were not delivered. The officers of the association wish to thank those who did take traffic from 1COS, 1BZJ and 1JB and relayed or delivered it. 1AJK of Worcester deserves the credit for the way he stood by for those two days giving us all help in getting the traffic off in his direction. I hope that next year when we have a booth we will be able to hit the 100% mark, and we can do it with the coöperation of the gang. Again I wish to take my hat off to the few but "royal hams" who did coöperate with us this time.

—Walter H. Kozaczko, Sec'y, Blackstone Valley Radio Association

The Splatter System?

Syracuse, N. Y.

Editor, *QST*:

Are we to gather from E. O. Hurlburt's letter in September *QST*, that an ideal 10-meter beam transmitter can be had by arranging a sea water tank atop the house and allowing the water to spray down behind our 10-meter vertical antenna?

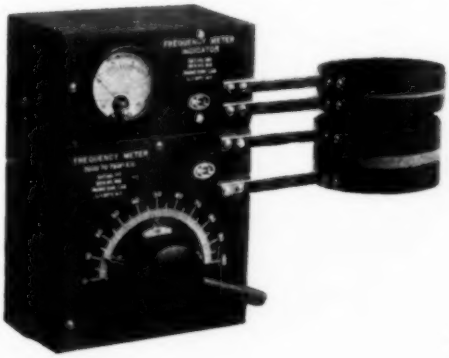
Would you suggest a pyrex pump to return the water to the tank?

—Alfred R. Marcy, Chief Engineer, WFBL

EXTRA THE REL NEWS EXTRA

VOL. I NOVEMBER, 1928 NO. 4

Showing New Receiving-Xmitting Coils for 1929
More About Frequency Meters



Frequency Precision Obtained With This Meter

The findings of the A.R.R.L. Technical Development Staff are to the effect that a certain, single capacity cannot be shunted by various coils, and give complete coverage of each amateur band. The new REL Frequency Meters provide a separate coil and condenser for each band. Each meter is accurately calibrated to 1/10 of 1% of the measured frequency by means of a crystal standard.

These frequency meters utilize one of the most accurate resonance indicating systems known. Extremely sensitive and permitting of very loose coupling between transmitter and meter. These meters should be the most important piece of equipment in every "ham" station.

Precision equipment will be an absolute necessity for all stations that are operating after January 1, 1929, because of the narrowed bands and because of the drastic consequences if a station operates "off wave."

The REL Precision Frequency meters

FILL THE BILL

The New Plug-in Coil

Efficient operation is assured by the use of these plug-in coils wound on one piece bakelite forms. Threaded ribs allow accurate space winding. Construction embodying three windings on one form permit quick changing. Special Spring contacts to take the coil plugs. Employing heavy copper enamelled wire they are suitable for high frequency receivers and 210 type low power transmitters.

The coils are used with the new condensers described in Bulletin No. 2. Together they make a working combination that will set new standards for Short Wave performance.

The plain bakelite forms may be obtained to wind your own coils or they may be obtained complete and wound for transmitting and receiving work. They are also used in combinations of three or four to make kits for the popular circuits.

Free and useful information on How to Build and Use New 1929 Receivers and Transmitters is yours for the asking. Five modern high frequency receivers, including the well-known Standard Regenerative receiver, the circuit employed in the Screen Grid Tube and a Special Super-Hetrodyne is described.

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Bulletin is Ready—Write

BETTER REL APPARATUS

Beginners

6 Airlie Street,
Worcester, Mass.

Editor, *QST:*

Here is something that has been on my chest for some time, yes years in fact. Mr. Brown's letter in the July *QST* prompts me to unload it. First and foremost, get me right. I certainly agree with Mr. Brown that we should all have patience with the new hams and give them a slow and good QSO when they call us or when we answer their call. If they ask us to QTA or QRS, do so and be a good scout and not a snob. We were all beginners and well do I remember my own feeble attempts some years ago to get the other fellow's drift.

Now for the load! A number of times, I have had the following happen and only recently was it brought back to me with force. I worked a chap who asked me to send slowly as he was a beginner. I, at once, changed to ten per with QSZ. He gave me a report good enough for any conditions of the air but asked me to send slower. I cut the speed to about six per with QSZ and still he was unable to get what I said. About this time, I realized I was in for a long session and rather than cut it short, repeated the dope all over again and still nd. Now, what would you old timers do in my case when he came back and said he was sorry but would I please send slower? This time I went down to nearly zero per and got "rr ok". Well, that was better, but I saw that there were no signs of my getting away so I reconciled myself to my fate. Now, fellows, it became necessary about this time to call it off so I did but was out of luck as he did not get me. Wasn't I justified in giving him my 73?

Well, I am perfectly willing to spend some time wit hanyone but if he is not able to copy ten per or anywhere near it, he has obtained his license in some incorrect manner and whoever signed his papers is responsible for his being on the air before his time. If a fellow can't copy the required speed, he must expect a little rough treatment. No one should be on the air who can't copy ten per with signal strength and atmospherics considered.

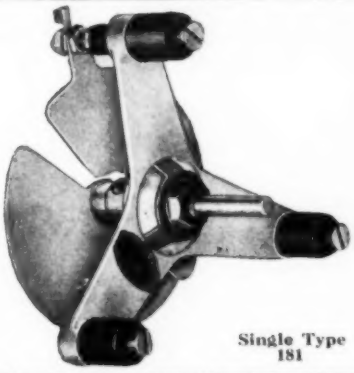
—*Clarence J. Green, 1ASU-1BCO.*

(Continued on Page 78)

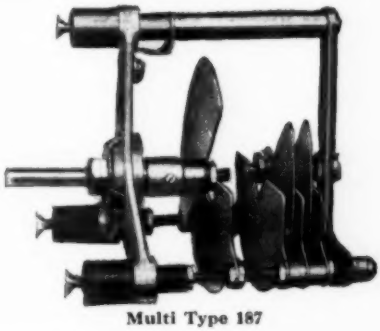
EXTRA THE REL NEWS EXTRA

VOL. 1 NOVEMBER, 1928 NO. 2

NEW CONDENSERS SHOWN FOR FIRST TIME-- EXPERTS SAY "SENSATION OF YEAR!"



Single Type 181



Multi Type 187

EFFICIENCY AND DX ABILITY NEVER EQUALLED

Announcements of radical new apparatus are not daily occurrences at REL. So when they come, you sit up and look alive; for experience has taught you that REL is pioneering for the good of amateur radio; that they are developing equipment to meet the needs of changed operating conditions. These condensers are what you've been waiting for. They solve the riddle of the narrow bands and afford satisfaction heretofore only hoped for. Nothing has been spared in order to make these condensers THE BEST. The results are gratifying; and after all, only results can substantiate our story.

NEW! NEW! NEW!

1929 Receivers and Transmitters

How to Build and Use Them

A booklet which describes the construction and operation of five modern high frequency receivers is now ready. Included among these are the well-known Standard Regenerative receiver, a circuit employing the Screen Grid tube, a special Super-Heterodyne, etc. A companion book on 1929 transmitters and circuits will be ready next month. Before contemplating reconstruction, secure this new REL data. It's Free.

CONSTRUCTION EXPLAINED FACTS SPEAK FOR SELVES

The new Variable Receiving Condensers are shown here for the first time. These condensers will be an absolute necessity in 1929, when the wave bands are narrowed causing great congestion. Using either of the new condensers will allow the operator to spread each waveband over the entire tuning scale of his receiver. Several outstanding features are: die-cast aluminum end supports, giving extreme ruggedness. Large single conical bearing, which prevents end play or side thrust. Insulated stand-off bushings, enable these condensers to be mounted on metal panels. The rotor tension is maintained by a large three finger bronze spring, assuring positive, even action during the complete rotation of the rotor. A patented rotor plate contact assures absolutely noiseless action. The rotor shaft revolves in a pool of mercury, making a perfect constant contact. Both the Stator and Rotor plates are of extra hard, heavy sheet brass and the shaft is standard ¼" allowing the use of any dial.

REL Catalogue No. 181 is a two plate variable condenser, so arranged that the stator plate may be moved permitting any desired maximum capacity to be obtained. This condenser adapts itself to frequency meters and high frequency receivers and is advised by Mr. Hull of the American Radio Relay League on page 14 of the October QST.

REL Catalogue No. 187 is a combination semi-fixed tank and continuously variable vernier condenser. This model is so arranged that a perfectly large semi-variable air-spaced condenser is shunted by a continuously variable two plate condenser. The tank portion of this condenser may be set at a certain desired capacity and the variable element can be used to cover only the exact frequency band desired. A special feature of this condenser is that a pre-determined setting of the tank circuit may be indicated on a disk on the tank rotor shaft enabling constant re-setting to any desired capacity. This condenser may be advantageously used in a low power transmitter where a "High C" circuit is desired as on page 26 of September QST exceptionally adaptable for receivers where a stated "lump" capacity is needed for each coil so that the continuously variable vernier will spread each band over its entire tuning scale.

The ideal condenser for Westman's Traffic Tuner. (September QST).

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Write for Information

BETTER REL APPARATUS

Strays

For those who are using remote control relays for the making and breaking of the power supply circuit to the transmitter and are objecting to the amount of juice used by the relay it is suggested by oh6DB that a solenoid type of relay be used. He finds that a solenoid and plunger arrangement in conjunction with chain-pull socket works very well. A fuse can be screwed into the socket to complete and protect the circuit. The relay can be operated with a single impulse rather than a continuous current which must flow all the while the circuit is to remain closed.

Calls Heard

(Continued from Page 43)

KUTM, Steamer John P. Reiss, Clyde C. Richelieu, Operator

(40 meters)

w1avg w1aep w1bkf w1bfz w1cq w1bux w1xi w1xk w1xv w1cnf w2al w2aue w2agn w2ahh w2ahi w2aim w2alu w2bmm w2com w2adm w2aot w2ban w2bm w2ctp w2ctq w2dg w2nf w2wd w2bg w2bkz w2avp w2ea w2xaf w3ard w3anu w3aua w3oh w3tq w3dqv w4js w4mx w4nu w4rq w4ut w4aar w4hk w5nad w5aug w5afe w5afx w5ark w5bj w5bjc w5gf w5jc w5mf w5mx w5ql w5uo w5vc w6czc w6xb w7lz w7id w8ahc w8alu w8bci w8bcu w8bky w8blb w8bm w8bmc w8bts w8cau w8cnt w8cze w8cx w8ddc w8dcm w8ccw w8dde w8dgb w8cft w8cnz w8ejo w8bgy w8dvl w8hx w8jj w8li w8wo w8iu w9ack w9acu w9ake w9aqe w9bbl w9bga w9bhz w9bnf w9bpq w9bwa w9cej w9cjh w9cph w9arf w9arm w9axo w9axu w9aug w9ben w9cn w9aug w9bab w9bam w9cek w9dap w9doj w9dwk w9dzw w9csd w9cyb w9dcn w9dlm w9drj w9dwd w9efc w9eca w9enb w9czd w9ecd w9egp w9eho w9eji w9elb w9enn w9eqc w9exc w9eyh w9eqk w9dyw w9bpl w9ben w9dfj w9ayu w9bkz w9cjs w9dbk w9dzl w9brp w9btq w9ccr w9dwm w9db w9ayx w9fdr w9fyg w9fac w9fdy w9flb w9fis w9fjd w9fkz w9fuy w9fsn w9epe w9fqs w9flg w9kv w9lf w9kd w9jmi w9mi w9mq w9my w9rc w9ll w9od on-2ra on-2ns on-3kr on-2yi on-5mb on-3vp oz-4am sc-2ab su-2ak velbr velcb k7to k4aaw.

(80 meters)

w1bld w1cra w1cos w1ga w3agg w4afw w8aaf w8arb w8arx w8bbr w8cno w8ddm w8dsf w8li w8dpi w9bxr w9bwz w9cvi w9czf w9dld w9dek w9dgw w9dsc w9ekw w9eru w9faw w9fdw w9efu w9ge w9qd.

(20 meters)

w1anh w1alb w1blu w1blv w1ccz w1ckb w1cio w1da w1df w1kq w1jr w2azo w2bdj w2bac w3ath w3aqm w3cx w3bph w4gd w4vc w4anq w5amn w5baz w5bbc w6ano w6csj w6cuh w6bpm w6dwi w6dwp w6no w7si w9afx w9aqz w9avy w9baz w9neb w9bkz w9ccp w9cub w9efe w9fyp w9us nc-4io sc-1ah nj-2gx g6by g6ut.

W7MF, Harold D. De Voe, R.F.D. 2, Medford, Oregon

ac1pp aj2by aj2dk aj4ak aj4dk aj4zz aj7mf jxix ef8orm fi1ab foa3e foa3z foa4e foa5o fq8hpg k7to nj2pa nm1g nm9a nn1nic nn7nic nncab nq5f1 nq5ni nq5ry nqpwv nt2fp nx1xl nzfr5 oa2ac oa2cg oa2hm oa2kj oa2lj oa2ns oa2rx oa2yj oa3ax oa3cp oa3hc oa3kr oa3vp oa3wx oa3xo oa4ab oa4bb oa4rj oa5cm oa5hg oa5ja oa5wr oa7ch oa7cw oa7dz oa7jk od1jr od4as k6ch k6clj k6ekx oobam oplad oplcm oplhm oplhr oplpb oplpl oplrc op9pl oz1ar oz2ab oz2ae oz2bi oz2bz oz2gp oz3ai oz3av oz4am sblaw sb2ay sc2ab selem se2ea spcbl ve3bm ve4di ve4dg ve4dj.

W1BUX, DH. Borden, Touisset, Massachusetts

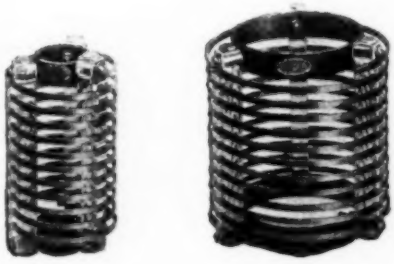
(20 meters)

ea-jh eb-4au eb-4bn eb-4rs ed-7bb ed-7hp ed-7rg ee-ar9l ef-1m ef-8axg ef-8bf ef-8btr ef-8ca ef-8ct

EXTRA THE REL NEWS EXTRA

Vol. I. NOVEMBER, 1928 No. 5

10,000 Inductances Now in Use. New Transmitting Condensers Going Fast

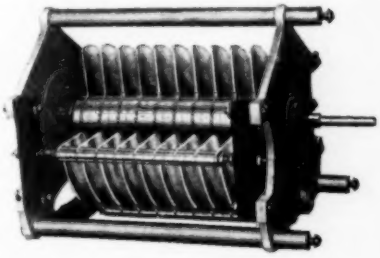


Now Famous REL Transmitting Inductances. Peerless For Years.

REL inductances need no introduction to the thousands of Amateurs who have been using them for years. Here is one piece of apparatus that has won the acclaim of all who know that a transmitter needs inductances. Flatwise wound copper nickel plated wire mounted on crystal glass spacers, they should be used in all circuits using 1-1000 Watts.

There are two types, "L" for 40, 80 and 150 meters wave lengths and "S" for 20 meters and less. Single and Double Units are obtainable in either type. Single Unit includes three clips and the Double Unit has six clips and two glass coupling rods.

If you have not yet used these inductances, don't wait any longer. Join the ever increasing ranks of those who use the best—REL Products.



The Transmitting Condenser That Has Caused a Sensation in Short Wave Field.

Introduced as a Super Condenser for the Super-Set, it won immediate attention and popularity. It is used in all the famous REL higher powered transmitting kits and is in increasing demand by set builders. It is a job that is built to stand the gaff. It will prove its true worth under severest service conditions. To say that the construction is Sturdy is but to scratch the surface. Heavy brass plates—cast aluminum end plates —husky steel rotor shaft—conical adjustable bearings. Best possible insulation assured by the use of heavy isolantite blocks—accurate spacing and Over all strength carried to an access. That is an outline sketch of one of the finest Condensers designed for Short Wave Transmission. Specifications on request. They may now be found in Leading Amateur Stations, U. S. Army and Navy, Commercial Stations and by others who know the best.

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ef-8eo ef-8fd ef-8gdb ef-8hip ef-8ix ef-8jr ef-8orm ef-8pro ef-8sm g2ao g2bm g2ex g2kf g2lz g2nh g2nu g2od g2sc g2vq g2xv g5bq g5br g5by g5bz g5hs g5ls g5ml g5ms g5qv g5us g5uw g5ux g5vl g5wk g5wq g5yk g5yx g6bd g6by g6ci g6cr g6gz g6hp g6ig g6nx g6oo g6pa g6qb g6rw g6sm g6ut g6vj g6vp g6wl g6wy g6xp g6yd g6yv ei-1au ei-1dy ei-1gw ek-4yt el-1aig em-smuk en-opt en-owim en-owr en-oyy xen-ocp eo-18b ep-1aa fm-8kf fm-tun2 fq-8hpg fq-ocy ne-8ae np-4adz np-4xk nq-2kp oa-2ac oa-2rx oa-2uk oa-2rx oa-2yl oa-3uc oa-5bj oa-5dx oa-5hg oa-7ch oh-6dsd oz-1ar oz-2aw oz-2bp sb-1at sb-1aw sb-2ig sc-1ai sc-3ac sc-3cj wnp.

(40 meters)

ea-jh ea-rx ea-th eb-4au eb-4bc eb-4di eb-4fp eg-4ft ed-7ly en-ar28 ef-8axq ef-8btr ef-8eo ef-8er ef-8gdb ef-8jf ef-1x ef-8udi ef-8vu ef-8vvd ef-8wb ef-8xd ef-8zd g2gk ei-1dy ei-1gw ek-4au ek-4rm ek-4uf ek-4yo ek-4yt em-sldg en-ozf ep-1ae ep-1bv ep-1cf xep-1ma et-1f et-tppt fm-ocup fm-ain fq-ocya fq-pm ne-8rg nj-2pa nm-9a nn-1nic nn-7nic nn-9nic hp-4ug nq-2aq nq-5ay nq-5by nq-5cx nq-5fc nq-5fl nq-5ry nx-1xl oa-2ac oa-2aw oa-2bc oa-2cu oa-2fp oa-2hc oa-2hm oa-2ij oa-2jw oa-2jy oa-2kj oa-2kr oa-2mh oa-2no oa-2ns oa-2rc oa-2rf oa-2sm oa-2tm oa-2xr oa-2yj oa-2yi oa-3ax oa-3bq oa-3cp oa-3gr oa-3gt oa-3hc oa-3hl oa-3jk oa-3ks oa-3lp oa-3ls oa-3my oa-3pm oa-3vp oa-4cg oa-4nw oa-4ra oa-4wa oa-5by oa-5cm oa-5dx oa-5hg oa-5ja oa-5jh oa-52p oa-5rj oa-5wh oa-5wr oa-5xg oa-6mu oa-6sa oa-7bq oa-7ch oa-7dx oa-7hl oa-7jk oa-7lj oh-6bqh oo-1aj oz-2ab oz-2aw oz-2ba oz-2bo oz-2ga oz-2go oz-3aj oz-3av oz-4ao oz-4av su-az2 sa-dh3 sa-dq4 sb-1ah sb-1ai sb-1aj sb-1aq sb-1ar sb-1as sb-1aw sb-1be sb-1bm sb-1bo sb-1bs sb-1id sb-2ab sb-2ad sb-2af sb-2ah sb-2 l sb-2ay sb-2az sb-2bf sb-2bg sb-2br sb-2in sb-2ih sb-fpl sb-snni xsb-2ak sc-1ah sc-1ai sc-2ab sc-1em sc-2ea sg-a7 sp-cbl sp-jsl su-1cd su-1cg su-2ak su-2bt.

E. O. Schwerdtfeger, S.S Margaret Dollar, KDUV

w5cj w6acz w6alm w6akg w6aov w6arb w6asj w6avj w6avl w6bdy w6bhy w6bqh w6ch w6chl w6chn w6cut w6cyx w6dfm w6dfs w6dkh w6dkv w6dlx w6dnm w6dwi w6dwn w6dwz w6dxt w7aax w7ac w7ar w7akv w7aik w7alr w7ep w8mi w7mo w7nr w7ou w7sw w8bor w9hak w9pl w9rm ve5an oz-2gp op-1cm op-1dr op-1hr.

Ernest L. Petit, 8307 S. San Pedro St., Los Angeles, Calif.

w1mk w1si w1ajx w1bgq w1cmp w1kr w1ack w2apy w2agl w2art w2bfq w2bad w2baz w2aup w2qs w2gx w2kr w2bip w2alu w3am w3jo w3aim w3bsj w4afk w4ix w4rm w4vx w5uk w5afx w5ain w5aug w5bat w5aih w5pk w8ajt w8bda w8aff w8bbl w8asc w8cqo w8cln w8dnf w9dkk w9dr w9us w9cub w9blw w9ems w9dzz w9hd w9cia w9fqn w9dqs w9aas w9bdt w9dzx w9axu w7dd w7ok.

Douglas Westfall, U.S.S. Farenholt, c/o Postmaster, San Francisco, California

w6dx w6ut w6bp w6al w6eh w6ya w6to w6bow w6eu w6ard w7nj w7ad w7ne w7eh w7mf w7tu w7zx w7ajz w9ld.

W1BYV, W. W. Smith, 300 Edgell Rd., Framingham Center, Mass.

eb-4bn ed-7zg ef-8bf ef-8ct ef-8dmf ef-8fd ef-8gdb ef-8hip ef-8hpg ef-8ix ef-8jd ef-8jr ef-8orm ef-8pro ef-8rpu ef-8rrr ef-8sm ef-8wb g2bm g2fn g2kf g2nh g2od g2sc g2vq g2xv g5br g5by g5bz g5ls g5ml g5ms g5qv g5vl g5wk g5yx g6dr g6hp g6qb g6qj g6ut g6vp g6wl g6yv ei-1au ei-1dy ei-1po ek-4jl ek-4yo ek-4yt em-smuk en-ovn ep-1aa ep-1ae fk-2ms fo-a3z fq-8hpg na-7mn qn-2kp oa-2bb oa-2rx oa-2yi oa-3ce oa-3gr oa-5hg oa-5wh oa-5wk oa-7mn oa-7lj oh-6clj oz-2ac oz-2ak oz-2aw oz-2bg oz-4aa sb-1at sb-1aw sb-2ab sb-2ar ac-1ah ac-1ai ac-3cj xen-1bd x-izz.

W. N. Haltwanger, Pettit Barracks, Zamboanga, P. I.

w4lx w5ao w5aq w5auz w5hv w5mx w5nw w6abg w6acg w6adk w6adv w6agr w6als w6am w6ap w6ard w6asm w6aux w6avd w6avj w6avz w6awa w6ax w6bfp w6bjd w6bvm w6bvx w6cgm w6cih w6cis w6cjv w6cuh w6cxi w6czr w6dca w6dcq w6dfm w6dgv w6dhg w6djq w6dmt w6dnm w6dnw w6drj w6dvg w6eah w6acg w6efe w6gu w6hm w6qf w6ru w6tj w6ue w7acx w7acv w7aix w7ajb w7bb w7bm w7gj w7ll w7un w8em ec-1ax ac-1bs ac-1cb ac-1tb

EXTRA THE REL NEWS EXTRA

VOL. 1 NOVEMBER, 1928 NO. 3

New Transmitters in Metal Cabinets Shielded and Stable--Best for 1929

Extremely Compact Equipment Comprises the Best of New, Improved Parts

Features of Construction Described in Detail

The new REL shielded transmitter is a radical departure from all other kits on the market. The advantage of shielding is universally acknowledged. The black crystalline finish metal cabinet presents a most pleasing appearance not usually found in a transmitter. New REL equipment specially designed for the 1929 bands is employed thruout. The construction is remarkably rugged and employs standard circuits.

Who Uses REL Apparatus:

REL equipment is utilized by the leaders of the radio world. In far flung corners of the Globe, you will find REL kits and products. Here's a partial list of REL users.

U. S. Army	WMCA—New York City
U. S. Navy	WCAP—Washington
U. S. Marine Corps	WAAM—Newark
U. S. Coast Guard	KDYL—Salt Lake City
General Electric	WFBR—Baltimore
Radio Corporation of America	WRNY—New York City
	KFH—Kansas
Westinghouse	KFPW—Missouri
Firestone Tire & Rubber Co.	KFJF—Oklahoma City
	WKBS—Illinois
WOR—Newark	WJAS—Pittsburgh

REL Shielded Kits may be used for any 7½ or 75 watt Hartley, tuned plate, tuned grid circuit or any variation of them.

The cabinets are electrically welded, insuring absolute contact on all sides. The panel of aluminum uses a wood base board and the panel and base board slide into the cabinet. These cabinets are of uniform height and are exceptionally well adapted for M.O.P.A. circuits using a 7½ watt oscillator with a 75 watt amplifier. Two cabinets side by side present a very neat appearance besides affording complete shielding. The top is detachable affording easy access to the interior. The sides are ventilated so there is no danger of the equipment heating. THESE KITS ARE THE ONLY ONES IN THE MARKET, WHICH ARE CONTAINED IN A METAL CABINET.

The 7½ watt kit is furnished with a new type No. 187 variable condenser and the new type No. 182 interchangeable plug-in coil.

The 75 watt kit uses the large type No. 149 condensers and the old reliable type No. 127 inductors. Weston meters are used in both kits, with other quality apparatus.

WRITE FOR FREE DATA

Radio Engineering Laboratories 100 Wilbur Ave., Long Island City, New York

Allen-Bradley Resistors
for
Experimental Work in Television

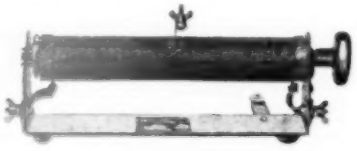
Bradleyunit-B

IF you are doing experimental work in television, use Allen-Bradley resistors, both fixed and variable. Bradleyunit-B is the ideal fixed resistor for resistance-coupled amplifiers as plate-coupling resistors and grid leaks because:

1. Resistance values are constant irrespective of voltage drop across resistors. Distortion is thus avoided.
2. Absolutely noiseless.
3. No aging after long use.
4. Adequate current capacity.
5. Rugged, solid-molded construction.
6. Easily soldered.

Radiostat

This remarkable graphite compression rheostat, and other types of Allen-Bradley graphite disc rheostats provide stepless, velvet-smooth control for scanning disc motors.



Laboratory Rheostat

Type E-2910 — for general laboratory service. Capacity 200 watts. Maximum current 40 amperes. A handy rheostat for any laboratory.

Write for Bulletins!

ALLEN-BRADLEY CO., 277 Greenfield Ave., Milwaukee, Wis.

Allen-Bradley Resistors

ac-2ck ac-2nr ac-9aa ai-2kt aj-jkzb aj-jxix am-3ab eb-4ft eb-4kb oa-2me oa-3hl oa-3ls oa-3wm oa-3ws oa-5bw oa-5by oa-7cw od-1jr od-2ab od-3bk od-4ar k6adh k6akg k6avl k6bde k6bhl k6boe k6bqh k6bxt k6ch k6dp k6dri k6dvg w6dwr.

I. A. R. U. News

(Continued from Page 45)

Radio Society of Great Britain is a necessary condition for membership of the Union, though there is no official connection between the two organizations. Up to the time of writing, 29 transmitting licenses have been issued in Northern Ireland, the majority of these being for a maximum input power of ten watts. In the past, most of the operating has been on 45 meters, 23 meters being used by about 6 station and 32 meters by about 4. The 90-meter wave has only been used rarely in the last few years.

"I shall now mention very briefly some of the achievements of the GI stations.

"In the summer of 1925, 5NJ established the first amateur contact between Ireland and U.S.A., and a few months later the first direct communication of any sort between Ireland and Australia was established by 6MU. Some time later, 6YW made a contact with Porto Rico, using 2 watts input, which was probably at the time a record for low-power DX. Since then, several distant countries, among them Indo-China and Jamaica, have had their first contact with the British Isles through GI stations, and we now have three members of the W. A. C. club (2IT, 5NJ and 6MU).

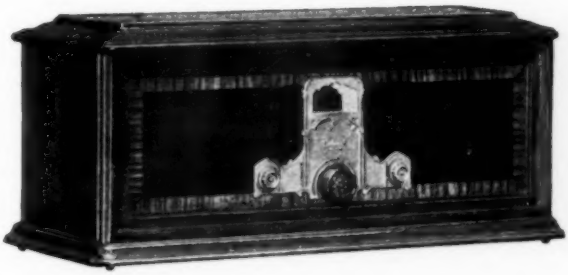
"In the R.S.G.B. QRP Tests of November, 1926, several GIs were near the top of the list, 6YW achieving the honor of being first in the British Isles. Special mention should also be made of 6TB, to whose painstaking the success of our Union is mainly due, and also of 6YW's recent work as honorary organizer of the R.S.G.B. Contact Bureau, an experimental organization whose work is already beginning to bear practical fruit.

"So much for the past. As regards the future, it is rather early to say much about the probable effects of the changes resulting from the Washington Conference. The conditions of operation will be as set out in the memorandum recently issued by the G. P. O. in London, except that the addition of the letter I to the British prefix G has been sanctioned for stations in Northern Ireland. gi2BX becomes GI2BX, and so on. The general opinion seems to be that the new conditions are not at all bad, and it is likely that a good proportion of the GI stations could operate under 1929 conditions with only slight improvements. It is probable that most of the operating will be in the 7 m c. and 14 m c . bands, though several stations intend to try 28 m c. in the near future. —*E. Megaw, GI6MU.*"

OCP

The many American and foreign amateurs who have worked this station will no doubt be glad to have some words from the chief operator regarding the origin and development of the outfit. We are sorry that "under cover" operation makes it impossible

Performance that Challenges the World!



FEDERAL'S engineering accomplishment, in producing the F11, has won the recognition and commendation of radio experts everywhere. Without question it out performs any radio receiver ever before placed on the market.

Antenna and ground operation with four stages of tuned radio frequency, detector, and two stages of amplification brings in the weakest of radio impulses picked up by the antenna and provides phenomenal distance range. Every part of the set bespeaks itself of precise standards of engineering and skilled workmanship. Every unit, including the individual tubes, is fully shielded. The chassis is all metal—the cabinet genuine mahogany.

Prices, without tubes, for battery operation $145; for light socket operation with Federal's power-tube coupler, 60 cycle, $220; 25 cycle $245. (Slightly higher West of Rockies.)

Ask the nearest Federal Retailer for demonstration or write for complete specifications.

Remarkable Federal Feats

A Federal Radio operated by an amateur in the crowded New Jersey broadcasting area established a world's record for DX reception when verification from 607 stations in all parts of the world were received.

FEDERAL RADIO CORPORATION, BUFFALO, N. Y.

OPERATING BROADCAST STATION WGR AT BUFFALO

Federal Ortho-sonic Radio, Ltd., Bridgeburg, Ont.

Federal Radio

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** Federal's fundamental exclusive development making possible Ortho-sonic reproduction is patented under U.S. Letters Patent No. 1,582,470*

Detection with the Screen-Grid Tube

Because progress has been slow very little data have been released on the use of the screen-grid tube as a detector, in which place it functions very efficiently.

In the October issue of Radio Engineering the latest first-hand laboratory information on the screen-grid tube's detector qualifications will be found.

The construction and use of a constant-frequency laboratory oscillator will be found also, as well as "The Engineering Rise in Radio," "Mathematics of Radio," etc.

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☐ Dealer ☐ Technician
☐ Engineer Anything else

to give the name of the ship or operator, but as stated, cards and reports may be addressed through the Dutch Section of the I.A.R.U., or through the A.R.R.L.

"For over one year's time now, with more or less regularity, xen OCP has been on the air and much pleasure has been derived by working many amateur stations. The op also pounds brass on a 2 kw. 500-cycle quenched-gap spark set on 600 and more meters.

"The works were started with the most friendly cooperation of three New Orleans amateurs, 5QJ, 5HR and 5UK, to whom xenOCP had been introduced by the Communications Department of the A.R.R.L. For the plate supply, a baby motor-generator was chosen, and the first tube was a one-dollar receiving tube, one of the items secured in your famous 5- and 10-cent stores! However, it soon became fed-up with its transmitting duties and retired.

"Back in Holland, the ship was exchanged for one circling Africa and a Philips 10-watter came on duty. In its present form, the set consists of a loosely-coupled Hartley circuit, housed in a small cabinet, with the coils, mounted on glass rods, on the top of it. It is grounded to the ship's earth and the aerial of spark set is used for the short waves also. This aerial is an inverted L type, two wires of about 80 meters each. The wavelengths in use are 32 and 19.6 meters, with optional 34½ and 44 meters, of which the 32-meter has proven to be the best. The m. g. gives about 300 volts, while the Philips 10-watt tube takes 60 milliamps. The receiver is a conventional O-V-1 (detector and one-step—A.L.B.) in shielded cabinet, to which a Telefunken screened-grid valve will soon be added.

"Along the east African coast, western NU stations can be heard best from 1330 until 1430 GMT, eastern NUs at about 0400, and most of them averaging R3-4. QRN, however, is very troublesome. After 2000, many Europeans are coming in *ok* on the 32-meter band, especially the EFs and EBs. eb4FT is the most consistent of all.

"In Durban the writer met with a very kind reception on the part of many FO hams, who attended the yearly convention of the S.A.R.R.L.

"xenOCP, whose QSL address is: Dutch Section, I.A.R.U., Noordwyk aan Zee, Holland, is always anxious to work amateur stations and glad to arrange schedules and tests, when these do not in any way interfere with his professional duties."

GERMANY

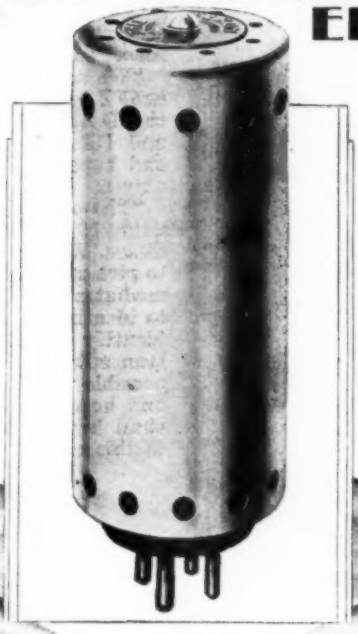
Germany is one of our national sections which is on the "honor list" by reason of having appointed an official correspondent and forwarding reports regularly each month.

"The most important event during September was our meeting during the holding of the annual Radio Show in Berlin (Announced in last month's issue—A.L.B.). Among the many hams who attended we had the pleasure of being host to eg6FI,

THE AMAZING NEW 5000 HOUR ELKON RECTIFIER FOR "B" ELIMINATORS

NEW, UNIQUE!

SOLID, DRY!



REVOLUTIONARY!

NOT A TUBE!

ONLY 200,000 AVAILABLE THIS SEASON

JUST as the Elkon dry, low-voltage rectifier revolutionized the design of chargers and "A" Eliminators, the new Elkon "B" type Rectifier will revolutionize the design of "B" Eliminators.

The Elkon EBH Rectifier plugs into any Eliminator using the former standard "B" rectifier tube. Simply take out the fragile 1,000 hour tube—plug in the husky Elkon EBH and the change is made. No changes in wiring—no adjustments.

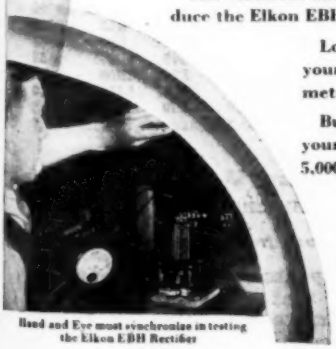
It is sturdy, solid, dry—has none of the frailties of a tube—not affected by accidental overloads or line surges. It is self healing. The power is smoother, quieter.

From the orders already received from dealers and jobbers in all parts of the country, we know that we will be tremendously oversold this season—only 200,000 of these revolutionary rectifiers will be available.

The elaborate manufacturing, testing and aging equipment necessary to produce the Elkon EBH Rectifier precludes any greater production the first year.

Look for the Red and Yellow display carton on your dealer's shelves. The new EBH is packed in a metal can.

Buy one from your dealer today! Plug it into your "B" Eliminator—Trouble free for at least 5,000 hours!



Hand and Eye must synchronize in testing the Elkon EBH Rectifier

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May be connected in series where the working voltage exceeds 1000. Through series parallel connections practically any working voltage and capacity can be obtained.

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1 mfd. condenser **$5.00**
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from London, et2UA, from Riga, and ekDCZ, Herr Johnske, the operator of Count Luckner's *Vaterland* on its visit to America. (And well-known as 'Fritz' to many West Coast U.S.A. hams, too—A.L.B.).

"Since last month, DX conditions have not changed very much, and there is little to report in this direction.

"We are pleased to state that eg6PP and eg6FY have become members of our society, the D.A.S.D., their licenses being DEφ831 and DEφ852. We welcome them heartily and hope that others will follow their example.

"There seems little doubt that after January, 1929, we will be given new intermediates. We regret highly that it is necessary to give up our old and better system of intermediates. With them it has been very easy to identify the continent and country of the identify the continent and country of the transmitter. We also regret that it is not possible to get private transmitting licenses, and hope that by the end of the year we shall have good and favorable regulations to this end. 73's to all.

—E. Reiffen, Sec'y, D. A. S. D."

Standard Frequency Transmissions From WWV

(Continued from Page 42)

quency to be transmitted is then given. There is then a four-minute interval while the transmittnig set is adjusted for the following frequency.

Information on how to receive and utilize the signals is given in the Bureau of Standards Letter Circular No. 171, which may be obtained by applying to the Bureau of Standards, Washington, D. C. Even though only a few frequency points are received, persons can obtain as complete a frequency meter calibration as desired by the method of generator harmonics, information on which is given in the letter circular. The schedule of standard frequency signals is as follows:

East. Standard Time (P.M.)	Nov.20	Dec.20	Jan.21	Feb.20	Mar.20
10:00—10:08	1500	4000	125	550	1500
10:12—10:20	1700	4200	150	600	1700
10:24—10:32	2250	4400	200	650	2250
10:36—10:44	2750	4700	250	800	2750
10:48—10:56	2850	5000	300	1000	2850
11:00—11:08	3200	5500	375	1200	3200
11:12—11:20	3500	5700	450	1400	3500
11:24—11:32	4000	6000	550	1500	4000

The figures given above are frequencies in kilocycles.

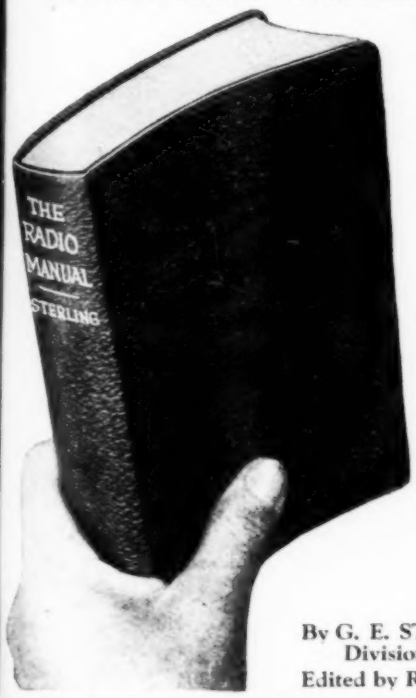
Experimenting With Bypass Condensers

(Continued from Page 38)

same time not bypass excessively the upper audio register, that value of capacity is best for the purpose. The following figures show the degree of bypass of radio frequency signals using the same audio fre-

Last Chance for Special Low Price!

The Radio Manual is about to be published. The special advance of publication price of $4.95 must be definitely withdrawn on November 15th—after which the regular price of $6.00 will be in force. Order immediately to take advantage of this unusual saving.



Radio Operators! Are you prepared to use the new International "Q" signals which go into effect January 1, 1929? Do you know the correct procedure for obtaining a radio compass bearing as prescribed by the terms of the International Radio Telegraphic Convention, effective January 1, 1929?—the right procedure when distress communications are ended and silence is no longer necessary?—what to do when you hear from a radiotelephone station the spoken expression **Mayday?**

These Questions and Thousands More Are Answered In

THE RADIO MANUAL

A Complete Handbook of Principles, Methods, Apparatus for Students, Amateur and Comercial Operators, Inspectors

By G. E. STERLING, Radio Inspector and Examining Officer, Radio Division, U. S. Dept. of Commerce.
Edited by ROBERT S. KRUSE, for five years Technical Editor of QST.

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8. Marine Vacuum Tube Transmitters including detailed description of Model ET-3626
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11. Spark Transmitters including description of Navy Standard 2 Kilowatt Transmitter
12. Commercial Radio Receivers and Associated Apparatus including, for first time in any text book description and circuit diagram of Western Electric Superheterodyne Receiver Type 6004C
13. Marine and Aircraft Radio Beacons and Direction Finders.
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15. Radio Laws and Regulations of the U. S. and International Radio Telegraph Convention. Quotations of all important sections
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QST

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quency transformer, but bypass capacities ranging from .005 μfd. to .002 μfd. and carrier frequencies of 15, 33, 100 and 1000 kilocycles.

	15 Kc. Percent	33 Kc. Percent	100 Kc. Percent	1000 Kc. Percent
.00025 μfd.	22	38	57	65
.0005 "	38	55	76	81
.0006 "	46	63	80	86
.00075 "	50	70	85	90
.0009 "	54	73	88	94
.001 "	57	76	89	97
.002 "	60	87	97	100

From the above, we glean the information that the .001-μfd. capacity is quite satisfactory for bypassing the radio frequency component remaining in the detector plate circuit after rectification. Since the frequency spectrum encountered in radio broadcast reception lies within the 550- to 1500-Kc. band, the values obtaining on 100 Kc. can be considered as criterion. As to the extent of audio frequency bypassing, this value of capacity bypasses only 6 percent on 5000 cycles. Consequently, the selection and use of a .001 μfd. bypass condenser in the plate circuit is consistent with sound engineering principles.

Now We're in the Air

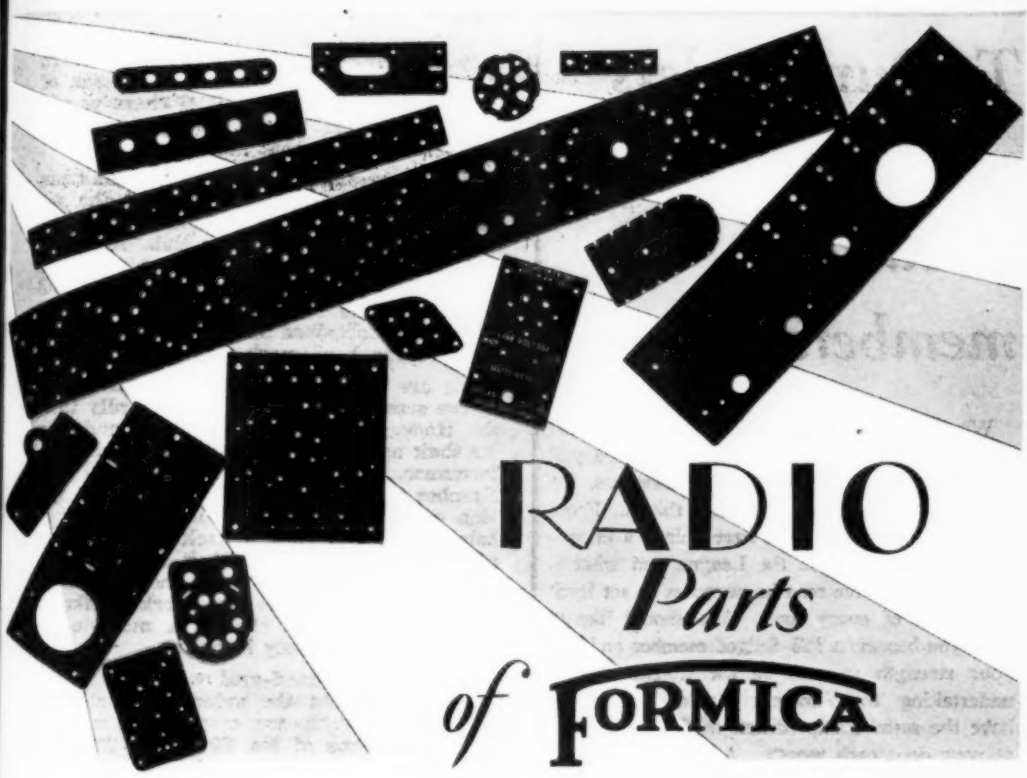
(Continued from Page 33)

is about to happen, "Mac" may be counted upon to be there with the proverbial bells (or buzzers) on. He sized the thing up and got into action.

Telephone and telegraph were out of the question as they were too expensive. Beside the expense, the installation of lines would take too long. Radio was the only solution but even that seemed rather costly —if they were to buy equipment and hire operators!

"Mac" got in touch with Robert B. Parrish, W6QF-W6PS, president of the Amateur Radio Research Club of L. A. and manager of the Pacific Engineering Laboratory Company, and explained the idea. "Bob" took to the idea like a small ham to a big bottle and put it up to the members of the A. R. R. C. They gave evidence of their hearty approval and made "Bob" master of ceremonies and installations but told him not to get too swell-headed about it because they expected to have much installation and few ceremonies and that he was also expected to do his share of the work. He did.

The stunt called for five complete stations with their separate sources of power, as there was no power at the pylons. This meant sets, tubes, and batteries, for the most practical operation. Now radio clubs are not usually overstocked with any of these things, especially tubes and batteries, so "Bob" sent out a QRR via land-fone to various friends. George Walters, western representative of the French Battery Company, came forward with "B" batteries for all transmitters and receivers, with each transmitter using 350 volts. The Durkee-



FOR fifteen years Formica has been furnished in changing forms to suit the convenience of the radio engineer and producer. In the early days it was sold in whole sheets and whole lengths of tubing and fabricated largely by hand by the radio builders. Then there were decorated front panels printed in gold and silver. Now there are sanded or threaded tubes punched and cut to length; washers; shelves; sub panels and terminal strips most of them shipped all ready to assemble.

At large expense Formica equipment has been changed from year to year to provide production in quantity at all times of insulating parts that would meet the requirements of the moment. And the quality and uniformity of the material has also steadily advanced.

The Formica Insulation Company

4620 Spring Grove Avenue
Cincinnati, Ohio

FORMICA

To Our Readers who are not A. R. R. L. members

Wouldn't you like to become a member of the American Radio Relay League? We need you in this big organization of radio amateurs, the only amateur association that does things. From your reading of *QST* you have gained a knowledge of the nature of the League and what it does, and you have read its purposes as set forth on page 6 of every issue. We should like to have you become a full-fledged member and add your strength to ours in the things we are undertaking for Amateur Radio. You will have the membership edition of *QST* delivered at your door each month. A convenient application form is printed below—clip it out and mail it today.

A bona fide interest in radio is the only essential qualification for membership.

American Radio Relay League,
Hartford, Conn., U. S. A.

I hereby apply for membership in the American Radio Relay League, and enclose $2.50 ($3 in foreign countries) in payment of one year's dues. This entitles me to receive *QST* for the same period. Please begin my subscription with the ..... issue. Mail my Certificate of Membership and send *QST* to the following name and address.

.....

.....

Do you know a friend who is also interested in Amateur Radio, whose name you might give us so we may send him a sample copy of *QST*?

.....

Thanks

Thomas Corporation sent two "Western" 6-volt storage batteries per set to the field each day, freshly charged. The Western Auto Supply Co. donated a whole flock of tubes of various sizes. All of these people said they would take Christmas cards in payment. How's that for cooperation.

"Bob" supplied the main transmitters from his laboratory, and most of the receivers and the other transmitters came from the membership of the club. A period of feverish installation ensued, which began a short time before the races and ended a shorter time before the same. Licenses were finally obtained and calls assigned and most of the hard work was over.

We are sorry to say, maybe, that some of the sets at the pylons would hardly take the Hoover Cup for looks. They made up for their appearance, however, by their performance. 6EMH, for instance, at Pylon Number 2, was a first class replica of my idea of what the first set looked like that belonged to the O. M. himself. The coating of dust was so thick that it actually was necessary to blow some off the meters to read them. But the set worked like a charm, as did the others in more-to-be-desired and less dusty locations.

Tuned-plate, tuned-grid was used in all transmitters. At the pylons a short projecting stick at the top served as a support for the antenna of No. 20 or No. 22 wire, while the counterpoise was run out to a nearby post or tree. Nails and tacks driven into dry boards were the only insulators. Receiving antennas were supported by trees, posts, and sticks stuck into the ground, and ground connections were made to the pylon frame. Pictures of these installations are *not* furnished herewith because they didn't turn out good anyway, and because they would be a source of too much pleasure for the opponents of the "lo-loss" postulates. However, it would not be fair to fail to give due credit to the very snappy job at 6EMF, the control station in the grandstand. This good-looking and efficient transmitter was a panel-mounted affair, artistically and mechanically balanced. Suitable engraving enhanced the glistening black panels but, above all, the evidence of skilled workmanship stood out like a shining jewel. The only visible parts of the set were the specially-wound plate and grid coils, two good-looking chokes, and the tube—in this case a 7½-watter. All other parts were hidden behind panels.

Visualize a busy afternoon. There are 50,000 people in the grandstands. A veritable hill of humanity is gazing at the immense field before it, listening to brief announcements, paging, wise-cracks and what-not, from the announcer over the public-address system. A huge array of Army planes is just over to our right, lined up near the fence, waiting to go on duty. On our far left the Navy is well represented by a detachment of planes and their detailed crews, seemingly always active. Far

PRECISION

NATIONAL VELVET VERNIER DIAL TYPE N

This four-inch solid German silver National Velvet Vernier Dial, type N has been developed for use in amateur and other radio equipment requiring the utmost precision of logging. It is equipped with a *real Vernier* making accurate reading possible to one-tenth of a division. The mechanism is the original and unexcelled National Velvet Vernier design, approved and used by transmitting and receiving amateurs all over the world.

Rear view National Screen-grid, short-wave receiver, a non-radiating short-wave receiver.

The tuning knob is of Bakelite and when desired, a Bakelite apron will be furnished at slight additional cost for protection against high frequency burns when the dial is used on high power appliances. Dial attaches to the face of panel at three points making accurate mounting exceedingly easy and simple. The type N dial is made with 3 different styles of division, 100-0, 150-0 or 200-0. List Price $6.50.

Write today for short-wave bulletin No. 128 ST.

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Hartford, Conn. Stiff Binding

Gentlemen:

I've been wanting a better bound copy of the Handbook for a long time. Here are my two dollars.

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across the field, in a direct line with our little box on top of the grandstand, are the civilian hangars for visiting planes and non-contestants. Directly in front of the grandstand is a large white circle on the runway. This is used for parachute jumping contests, exhibitions of bombing and numerous other stunts. Running out to the circle from the fence is a connecting white line, used for the "dead stick landing" contests, up to which the winner, making a landing with a "dead" motor, came within three feet.

Over to the left again, in front of the Navy planes, is another white line. Six planes are lined up along the line with motors idling, waiting expectantly. Adjoining our "box seat" in the radio shack are two observers who tell us that Event Number 3 is about to start and is a "free for all," open to all types of ships powered with motors of 720 cu. in. displacement or less, but open to civilians only. The distance will be fifty miles—ten laps of the five-mile course—and prizes will total $1,500. The operator at the headquarters station (6EMF) at our elbow sends out the following:

"QST QST EVENT NR 3 ABOUT START FREE FOR ALL QRX RACE 6EMF."

He turns the dial between two points, about four "degrees" apart. He finds 6EMH. Pylon Number 1, at 54 on the dial. 6EMH says: "QST OK DE 6EMH AR." He turns the dial to 49.5 and he hears 6EMI at Pylon Number 3 say "QST OK DE 6EMI AR." He would find 6EME, Pylon Number 4, at 45.5, but they are not using this pylon in the five-mile race.

Suddenly the starter twitches his flag and the racers roar toward 6EMH at ten second intervals. 6EMF sends another QST to all pylons: "THEY'RE OFF."

Let's drive out to 6EMI and watch this race from there. The watchman at Pylon Number 3 has a big jar of ice water and there's not so much dust here. Here they come! You'll have to look sharply because...Good nite! *He's coming right at us!* Let me get out of here.. here...No, you see he suddenly makes a vertical bank and roars around the pylon and is gone. Whew! That seemed close, though, especially from our lookout *in* the pylon. They travel comparatively close to the ground, only a few feet above it, and they appear to be attacking us. But we soon get used to that. Here comes a bunch. In four zooms and a sputtering roar they appear, roll over on their sides, make a ninety-degree turn, roll back again and are gone. We get so used to it that we don't watch them any more, and we see that the watchman, relieved during the race, has gone to sleep in his car.

Suddenly an observer calls: "Operator! Plane Number 159 fouled pylon! Sixth lap."

SM

We Think You Ought to Know—

TONE quality is an elusive thing—yet all-important. We think you want to know the truth about it—the whole truth. That is why S-M, in spite of having so much to talk about in the way of selectivity and distance range, keeps "harping" on tone quality. We can prove, by laboratory measurements and curves, that the new S-M Clough system audio transformers come closer to doing that than any others we have ever been able to find, at any price. But then, any advertiser can make big claims, draw curves and publish them—so that doesn't necessarily prove anything *to you.*

But IT'S TRUE, nevertheless. One by one we are getting reports of tests—made by impartial engineers for manufacturers and others who employ them—agreeing with our own findings that there is *nothing on the market* to match the tone quality that you build into an S-M set—or into any other good set, if you so desire—by the use of S-M Clough system audio transformers. That's what the engineers in the world's largest telephone laboratories said. It's what the professors of an old New England engineering school decided.

To the radio-wise public—those who decide, in the end, every question of comparative merit in manufacturers' claims—we offer to prove the absolute superiority of S-M tone quality in any fair way you can suggest. Here are, for instance, the two fairest ways we know of—and we're taking both of them:

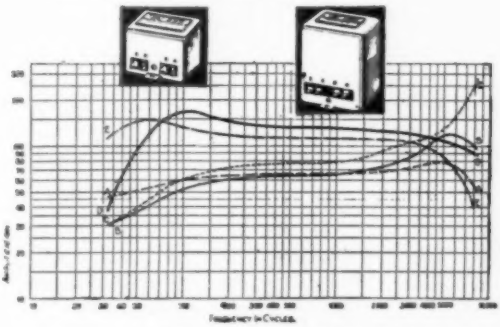
FIRST: We are building, and operating in the most public places we can find—the big radio shows, hotels, dealers' show rooms—comparison amplifiers which interchange instantly in a circuit, on throwing switches, a set of S-M transformers and a set of any other make desired. We are so well satisfied with the sales of S-M audios resulting from this "hard-boiled" method that we printed and distributed 35,000 copies of an article telling dealers and setbuilders how to build such a "comparator". *Do you know of any other transformer manufacturer who is doing that?* If not, why is S-M the only one who is?

SECOND: We are giving an absolute guarantee that the S-M Clough-System transformers you buy at $6.00 (list) cannot be surpassed by any transformers of the conventional type—not utilizing the Clough invention with its practical elimination of hysteretic distortion—*at any price whatsoever.*

If you have a laboratory, with a good audio frequency oscillator and sensitive high-frequency milliameters—by all means verify for yourself the sweeping claims we make. If you haven't—then listen to one of the public S-M comparator tests. If you can't do that—just try a pair. Ask your own ears!

We think you ought to know.

In the chart below, E is the two-stage curve for the large-size transformers (S-M 225, 1st stage; and 226, 2nd stage, $9.00 each); D is that of the smaller ones (S-M 255 and 256, $6.00 each). Note the marked advantage over A, B, and C—all standard eight and ten dollar transformers under equal conditions.



Are you receiving "The Radiobuilder" regularly? No. 5 (Sept.) described a Comparison Amplifier for comparing audio transformers. No. 6 (Oct.) tells about the new "PA" Public Address System. To S-M Authorized Service Stations, it comes free of charge, with all new constructional Data Sheets. If you build professionally, write us about the Service Station franchises.

Use your S-M ROUND THE WORLD FOUR on the broadcast band with these new S-M five-prong plug-in coils—131X for 190 to 350 meters, $1.25; and 131Y for 360-650 meters, $1.50.

SILVER-MARSHALL, Inc., 858 W. JACKSON BLVD. CHICAGO, - - U. S. A.

Silver-Marshall, Inc.
858 W. Jackson Blvd., Chicago, U. S. A.

....Send your complete catalog, with sample copy of the Radiobuilder.

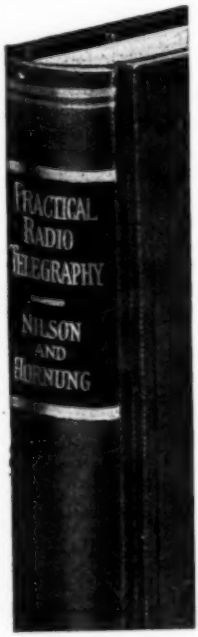
....For enclosed 2c stamp, send Data Sheet No. 4 on Audio Transformers.

Name.....

Address.....

Be a Commercial Radio Operator——

A practical book that should enable anyone of average intelligence to pass the Government's theoretical examination given to applicants for a Commercial Radio Operator's License.



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390 pages, 5x8, 223 illustrations
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The book covers in detail the theory and practical operation of every type of modern, 1928, commercial arc, spark, and vacuum tube transmitter. It furnishes complete data on commercial vacuum tube receivers. It covers everything from elementary electricity to the practical operation of radio compasses.

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Q.S.T. 11-1-28

The operator at 6EMI calls 6EMF at the judges' stand. As the latter is always in a continual state of "QRX" and is watching for information to flash to both pylons at the same time, only a few dots and dashes are necessary to raise him. He replies: "6EMI R K", and the following conversation takes place:

"PLANE NR 159 QFP (Fouled pylon) LAP 6 HW."

"OK QRX."

In about a minute: "6EMI DE 6EMF PLANE NR 159 DISQUALIFIED AND FLAGGED OUT NM QSU."

6EMI answers: "E E," and the watch is continued. The unfortunate pilot of Plane Number 159 who misjudged the distance around Pylon Number 3 was saved the trouble of going the last four laps. He was flagged out of the race almost within a minute after passing Pylon Number 3.

And so the race goes on. Few accidents marred the races so that the use of "QRR" for "crash" was rare. But the radio spoke of other things beside "QST TON" (Take-off numbers), "QFP," etc. Transportation was arranged for. Observers at each pylon were given detailed instructions. One day a fire was reported by means of pylon radio. Lost planes were located. An observer had a "date" in Glendale at a certain time, so what was the earliest time he could leave? When do we eat? How many more races are there to day and will they move Pylon Number 4 again after they get it up? Which foot were you using that time? QSD? And a thousand other things of varying importance.

After the first two days or so the novelty of the thing wore off, in spite of the diversified program. But the efficiency of the service remained above par throughout the entire period.

Chairman W. L. Schaffer of the Race Course Committee was asked how the radio had been. He replied: "The radio is O K. I am *very* much pleased with it."

And that, as an expression of the race officials, may serve as a hint as to the satisfaction derived from the accomplishment, by all parties concerned.

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APPROVED RADIO PRODUCTS

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Small in size, but a master instrument. Ask your dealer to show you the exceedingly fine adjustment and velvet smooth action. Diameter, 1 7/16 inches.
Up to 400 ohms 75c
1000 and 2000 ohms $1.00
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RESISTANCE UNITS

Here is where you need absolute dependability and you get it with Yaxley Resistance Units. Run true to rating. Convenient screw eye and soldering lug terminals for easy mounting. Filament and grid type; one to 3000 ohms .....15c to 40c

YAXLEY MFG. CO. Dept. S, 9 So. Clinton St., Chicago

160 Meter Low Power Transmitter

(Continued from Page 37)

key and, listening on your own receiver for the signal, turn the dial of C1 until the wave is within the legal band. Then adjust C2 and the taps on the antenna inductance until the 25-watt lamp in the primary of the plate supply transformer glows at about medium brilliancy. At this point, which is a sharp one, the two circuits are in resonance with each other. The transmitter is now in a working condition, so open the key and listen on your receiver for some station's signals. Then put the completed station in operation by calling the station heard.

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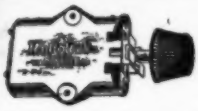


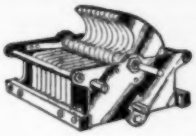
Bradley Leak, absolutely noiseless and stepless, **2.95**

2000 to 30,000 ohm resistance. List $5, special $2.95.

94. Bradleystat No. B-210 Special 1.60

Signal Buzzer Set international Code on Baseboard $2.45

Belden braid ¼ inch wide, ft. .06



Cardwell condensers, double spaced for transmitting, .00025 cap. **3.45**

No. 12 Enameled copper wire, any length, ft. ..... $.01

No. 10 Enameled copper wire, any length, ft. ..... .01½

Genuine Bakelite Panel 10x14x¼ 1.50

Baldwin phones type C, pair 5.95

Myers $5 4½ volt Det. or Amp tube, complete with mounting clips ..... .85

SPECIALS

Dubilier Mica Condenser .002 cap. 6,000 working volt 1.95
General Radio 247D .001 cond. plain or with vernier 1.75
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Dubilier cond. .5 mfd. 1,000v D.C. working voltage .85
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Ward Leonard Resistances; fits standard base receptacles; sizes 300—600—900—1200 and 3000 ohms .95
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Ward Leonard Resistance

$4.75 list-6½ inch long—800-1000 -1200 -3000 -6000 -8000-11000 ohms; can be used for 2-50 watt tubes or less, **$1.45**

$7. Acme B-6—"B" eliminator transformer, 235 v. each side of centre tap. 2.45

Acme 500 w. plate transformer, 1000-1500-2000 each side of centre tap, 24.00.
Acme B.H.-1 transformer, 255-510 each side of centre tap; also 2 fil. windings of 4 v. each side of centre tap, $10.25.
Acme C.W. 20 Henry choke. $18 list — 150 M. A. single $14.40; also other sizes at special prices.

Pyrex Low-loss V.T. sockets, each 39c.

Flechtheim Condensers, all types 35% off list.

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General Radio No. 358 Short Wave Meter, 14 to 225 meters, list $22, special $14.50.

ACME POTENTIOMETER RHEOSTAT

A combined Pot. and filament Rheo.

6 ohm rheo-100 ohm pot.
30 ohm rheo-100 ohm pot.
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TWIN RHEO for low voltage tubes. List $3.00. Special each 65c

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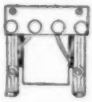

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A high quality choke 1/10 Henry at 100 mils.
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GENERAL RADIO *Type 285* AUDIO TRANSFORMER

Ideal for high and even amplification.

Type 285-H—6 to 1
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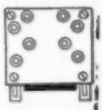
List $6.00 Now only $3.25

ACME VARIABLE RATIO AUDIO FREQUENCY TRANSFORMER



Get any ratio you want.

SPECIFICATIONS

Type V A-2 Ratios Available					
Primary Binding Posts	Secondary Binding Posts	RATIO	Primary Binding Posts	Secondary Binding Posts	
2.5:1	1-4	5-6	4.25:1	1-3	5-8
3:1	1-3	5-6	4.75:1	1-2	5-7
3.25:1	1-4	5-7	5.25:1	1-2	5-8
3.5:1	1-4	5-8	7.5:1	2-4	5-6
3.75:1	1-2	5-6	9.5:1	2-4	5-7
4:1	1-3	5-7	11.5:1	2-4	5-8

On the primary side the binding post in use having the higher number should be connected to the B+ and likewise, the secondary post having the higher number should be connected to the grid.

By using binding posts 3-4, still higher ratios may be obtained if desired, but the above selection will usually fill all requirements.

Other specifications similar to type A-2. Price $7.00 each.
Special $2.75

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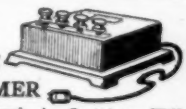
All necessary parts; operates from 105 to 125 volts A. C.—gives "A" "B" and "C" for amplification and "B" for set. Type 390 uses type 280 tube. Type 395 uses "B. H" Raytheon tube. List $50.
Special $19.50

MAIL ORDERS FILLED SAME DAY
10% Must Accompany All Orders

NEON GLOW LAMPS

Made by General Electric Co., type G. 10, standard base. 101 uses, as illustrated in QST May issue page 17
Price only 65c

RADIO FOUNDATION TRANSFORMER



Mfg. for McCullough A. C. tubes. Will carry 6 tubes or its equivalent—2½-3-3½ v. List $6.00 Special $2.25

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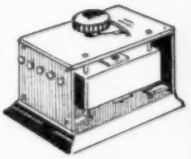

125 watt—110 volt—60c. tapped at-4-7-10-13-17-20-24-30 volts. Limited quantity. List $19.
Special $4.45

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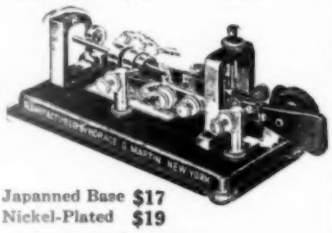
Japanned Base **$17**
Nickel-Plated **$19**

Famous Improved Vibroplex

Used by tens of thousands of operators because of its ease and perfection of sending.



Japanned Base **$17**
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Special Radio Bug

Equipped with Extra Large, Heavy, Specially Constructed Contact Points for direct use without relay . . . **$25**

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ELECTRAD

Official Frequency Stations

ONE cannot have read *QST* during the past few months without realizing that there are many changes to be made in amateur conditions when the effects of the International Radiotelegraph Conference is felt after the first of January, 1929. Under these new conditions it will be impossible for us to go along with our old opinions concerning the amount of accuracy that is necessary as far as the position of any signal in the frequency spectrum is concerned.

We have in the past been speaking in terms of wavelength and in accuracies of 2% in our Official Wavelength Station work. These will not do for 1929 and some major changes must be made in the requirements which these stations must approach.

QST has contained sufficient material on the reasons for referring to the position of a station in frequency rather than in wavelength to make a further discussion of this subject unnecessary. We, therefore, immediately find that we must give all reports in frequencies and the operators of these stations should make a distinct attempt, particularly during the next few months, to not only give official reports in frequencies but to adopt it as their unit of measurement and to learn to actually think in frequencies. About the quickest way in which this can be accomplished is to calibrate your present meter in frequencies and to put the wavelength calibration at the bottom of the biggest pile in the darkest corner of the shack—better still, destroy it.

When we change to the use of frequency the name which this service has borne becomes incongruous and even though sentiment may prompt us to hold on to an old friend, these echoes of the past are dangerous to our future and we will be much better off by starting from scratch. In accordance with this, stations in this service will hereafter be known as Official Frequency Stations or O.F.S.

Our new bands will be materially narrower than are our present ones and an accuracy of 2% as has been demanded in the past is entirely inadequate. Our old 40-meter band, for instance, will extend from 7000 to 7300 kilocycles and 2% of this band amounts to 140 kilocycles. There is, therefore, a band of only 20 kilocycles in the center of this band in which a report indicates that the signal is within the official limits of the band. In other words, if a report on a signal is given that is not between 7,140 and 7,160 kilocycles, the operator receiving the reports is not sure but that he may actually be outside the limits of the band. What is worse than this is the fact that with a 2% accuracy, no report can be given which indicates definitely that a signal is within the 14,000-kc. band as it will be in 1929.

It is impossible for us to obtain with this type of service a degree of accuracy which would be desirable and so it remains for us

If your radio doesn't operate a power speaker it's obsolete

This is the world's lowest priced A C Electric power speaker radio

NEUTRODYNE

Here is a radio designed exactly as the most costly receiver. New features that have marked radio advancement this year are incorporated in this 1929 set. The improved AC tubes! Shielding! Low voltage that promises long life to tubes! Volume control! Illuminated dial! Power speaker operation! And Crosley manufacturing methods have kept the price LOWEST of any genuine electrically operated radio. Crosley economies in production and marketing are directly responsible for the unmatchable price of $65. Crosley radios are outselling any others in every market. Sales nearly four times as great as last year's record breaking year, indicate the VALUE the public is finding in this latest Crosley success.

The Improved MUSICONE the fastest selling magnetic loud speaker at $15

$65 WITHOUT TUBES

operating the new dynamic ~ power DYNACONE

$25

You have a surprise and a treat in store for you. You will delight in the realism and beauty of its tone. You will be amazed so much is possible for $25.

Fearlessly Crosley led the radio industry to home trial before buying. On such a broad selling policy Crosley has won first place in the industry because buyers found Crosley radio outperformed many far more expensive sets. A home demonstration will satisfy you that Crosley is a GREAT radio.

8 tube AC Electric SHOWBOX $80
Genuine neutrodyne 3 stages radio amplification, detector, 2 stages audio (last one being two 171 push-pull power tubes) and 280 rectifier.

6 tube Battery Operated BANDBOX $55
The Bandbox is the ideal radio for places where electric current is not available for AC receivers. This receiver can be converted for use from the power lines by means of a suitable power supply unit. 5 tube Dry Cell Operated BANDBOX, JR., $35, uses 199 tubes with 120 power output tube. Ideal set where recharging of storage battery is in convenient.

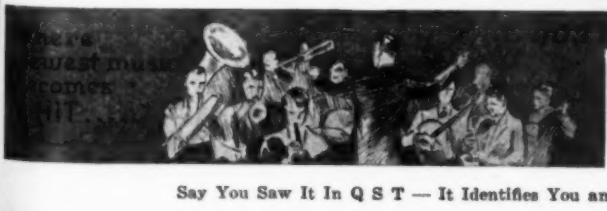
The FIVE DAY FREE TRIAL offer is copied on every hand but let any one deter you from comparing the Crosley with ANY set made. You need not be a radio expert to judge the VALUE Crosley gives you.

Be sure you have the new Crosley dynamic power speaker. For the first time in the popular price field its deep, resonant tone from dynamic power available is a speaker at $25. No one has even imitated it.

THE CROSLEY RADIO CORPORATION
Powel Crosley, Jr., President,
Cincinnati, Ohio

CROSLEY

Montana, Wyoming, Colorado, New Mexico and West, prices slightly higher. Crosley prices do not include tubes.



The Crosley Radio Corporation, Cincinnati, Ohio. Dept. 18.
Please send me literature about your new radio receiver and the new wonderful DYNACONE.
AC Radio..... Battery Operated Radio.....
Dynacone..... DC Radio.....5 DAY FREE
TRIAL IN MY HOME .....
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KINO-LAMP for receiving—List Price $7.50.

FOTO-CELL for sending—Prices and information upon application

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CAMBRIDGE, MASS.

Raytheon Foto-Cell

AMERTRAN PF-250

Power Transformer *for* UX 250 Power Tubes

A husky transformer built for doing the job, not for looks. The PF-250 is rated at 1200-600 volts plate, 7½ volts power tube, 7½ volts rectifier tube filament. Center taps are provided on each of the filament windings. Continuous rated capacity of plate windings, 160 M A., continuous rated capacity of each 7½ volt winding, 3 Amperes. DC plate output with two UX 281's full wave, up to 450 volts with sufficient excess for "C" Bias. *Ask for Bulletin No. 1033 describing fully the PF-250.*

Price, each—$30.00

Slightly higher West of Rocky Mountains

AMERICAN TRANSFORMER COMPANY

Transformer Builders for more than 28 Years

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to endeavor to maintain as high a degree of accuracy as can be obtained with the equipment that is available to the Official Frequency Stations. Our Standard Frequency Transmissions carry an accuracy of 1/10 of 1% and when one begins to realize the many problems involved in maintaining this accuracy over long periods of time, it is obvious that we cannot expect such precision from the O.F.S. As a result of much discussion, a figure of ½ of 1% has been decided upon as being a satisfactory compromise between the desirable accuracy and that which can be obtained without involving any considerable expense or work on the part of the operators of Official Frequency Stations.

Meters that are good to an accuracy of ¼ of 1% and better are available on the market at prices that should be within the reach of the O.F.S. It is possible for the amateur to construct his own instrument and calibrate it from the Standard Frequency Transmissions from W9XL and WWV. It is extremely desirable that frequency meters be checked at least once every two months to be sure that their calibration is still within the necessary limits. (Please let us know when you have taken advantage of these transmissions and if you have not already obtained report blanks we would be glad to send you a supply.)

Many operators prefer the use of megacycles when referring to the various bands. Unfortunately, it is impossible to specify a frequency in megacycles to an accuracy of ½ of 1% without the use of figures to the right side of a decimal point. That is, unless one is referring to a round number of thousands of kilocycles which may be satisfactory for designating bands but which is decidedly unsatisfactory when referring to frequencies within bands. This same thing applies to the use of wavelength in meters. It is possible to refer to any frequency within the amateur bands with an accuracy of ½ of 1% by using a full number of kilocycles. This means in practice that all reports may be given in figures of four or five digits without the use of a decimal point and still maintain the accuracy demanded of this service. This, then, constitutes an excellent reason for the use of kilocycles when the matter is viewed purely from a point of convenience.

This is not the only reason for its use, though. The International Radiotelegraph Conference made the kilocycle its standard unit in allocating all bands and our own Radio Division of the Department of Commerce has also adopted this standard. Our licenses specify our bands in kilocycles. Although the limits are also given in wavelength, this is only an approximate value. In view of these factors, we feel justified in employing the kilocycle for our standard unit and all reports should be given in kilocycles. Therefore, in transmissions no commas, periods or other punctuation are

Wide World Photo of the "City of New York," from a painting by Chas. Rosner, N. Y.

"We are Depending on your product,"

writes the Radio Engineer of the

Byrd

Antarctic Expedition

ON the Antarctic Expedition led by Commander Byrd,—as on his Arctic Expedition and Trans-Atlantic Flight—*PYREX Insulators will again be depended on for unfailing radio insulation.

These seasoned explorers dare not entrust the success of their expedition—and possibly their lives—to any equipment which had not proven its complete ability to withstand the extreme conditions to be met. Their complete confidence in them is ringingly expressed by M. P. Hanson, Byrd's Radio Engineer.

"We have every confidence," writes Engineer Hanson, *"that your products will render good service under the extreme conditions to be met, as they have done in the past."*

PYREX Insulators are not affected by acid fumes, smoke or salt fogs. Their exceptionally low coefficient of expansion makes them indifferent to sudden temperature changes. Their dielectric strength is from 15 to 35% greater than porcelain. Their power loss is lower than any substance except pure fuzed quartz.

For complete technical information and catalogs on either PYREX Power Line or PYREX Radio Insulators write

CORNING GLASS WORKS
Dept. Q-4, Industrial and Laboratory Division
New York Office: 501 Fifth Avenue

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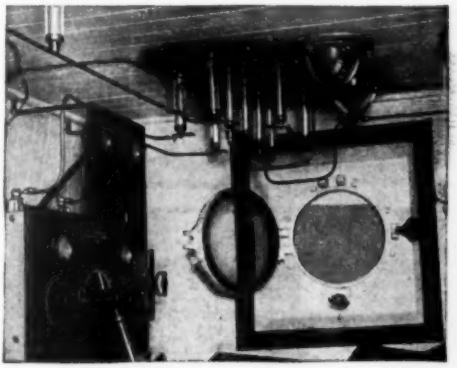
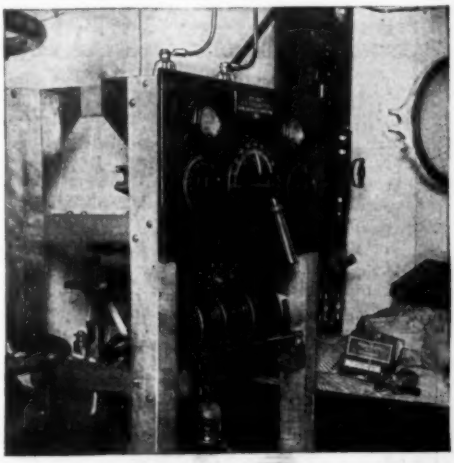


PYREX *Entering bowl and Stand-off Insulators on the ceiling of the radio room of the "City of New York." High power short wave transmitter shown on the left*



Lower Section of high power short wave transmitter equipped with PYREX *small Lead-in Insulators*

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UNIFORMITY ECONOMY

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FREE

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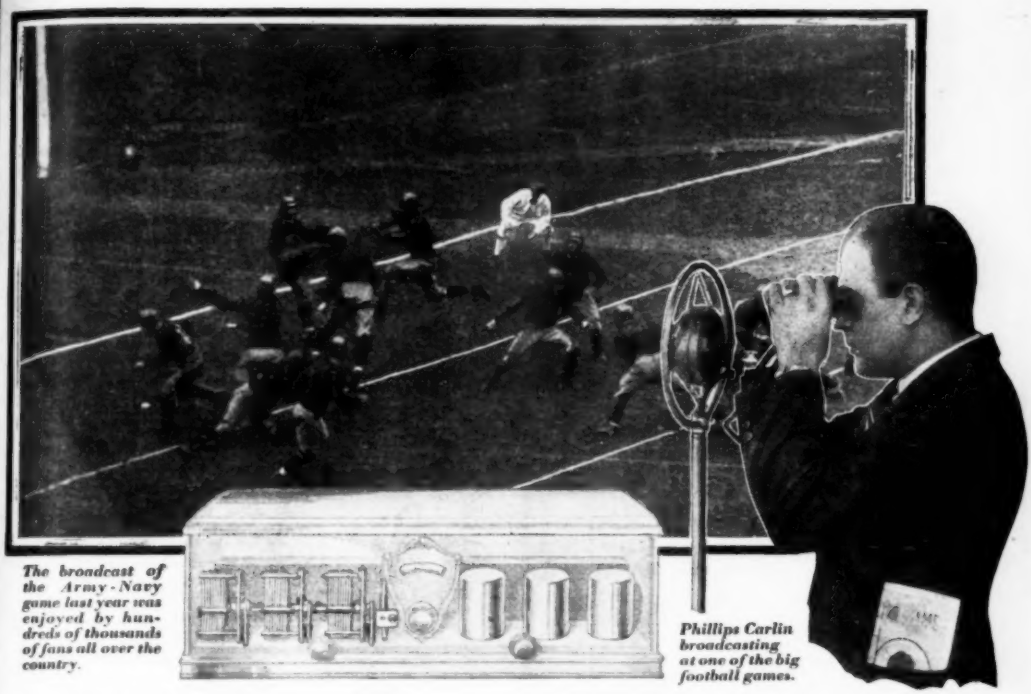
necessary to break up the group of four or five digits.

At the present time there are two factors that are used in converting from kilocycles to meters or vice-versa. The more exact one is 299,820 and the more convenient is 300,000. The more exact value differs from the other by 18 parts in 30,000 or 6/100 of 1%. This inaccuracy is insignificant in view of the ½ of 1% requirement and the conversion of wavelength-to-frequency is so much more convenient when using 300,000 that once more we can adopt a unit which simplifies calculations without, at the same time, sacrificing anything of importance. We also find that the Radio Division of the Department of Commerce has adopted this factor and that it was used by the Conference. A conversion chart for wavelengths or frequencies between 10 and 30,000 based on this figure has been issued by the Superintendent of Documents of the Government Printing Office at Washington, D. C., at the request of the Radio Division. Copies of this chart may be obtained at 5 cents each from the Government Printing Office. To assist the O.F.S. in changing over to kilocycles, we are having a copy of the chart sent to each one of them with our compliments.

The chairman of the committee handling Official Frequency Stations is Don C. Wallace, W6AM, and if you are already an O.F.S. but feel that you cannot meet the requirements specified above, please notify the Chairman so that your call may be deleted from the list. If you are not an O.F.S. and feel that you can meet the requirements satisfactorily we would be glad to have your call on the list. Communicate with the Chairman. The chief duties of an O.F.S. are to indicate the frequency of his transmission at the end of each transmission, to check the frequency of other transmitters when requested and to aid in the general work of keeping all amateurs within their assigned bands. This is done in the course of their general amateur operation. O.F.S. do not send Standard Frequency Transmissions.

The following stations are members at this time: W6XAO-W6ZV, W5MN, VE3FC, oz-2AC, W6AM, W1CK, W1AWW, W8EQ, W4XE, W5ZAV, W9EGU, W6ZH, W2MU, W4BY, W5SP, W7GQ, W2DS, W1BZQ, W6BGM-W6CVO, W9IG, W1ZL-W1AVW, W2CLA, W8GZ-W8ZG, W9BGK, G2NM, VE9AL, W8APZ, W5OX, W1AAC, W8BZT, VE3CO, G2OD, W6CAE, W9AXQ, W9CPM, W5EW, W1AXA, W9BGH, G2SZ, W6BB, W8DAJ, W9AUG, VE2BE, W2BRB, VE4BT, oa-5BG, W4LK, GI5NJ, W1CCW, W8BAU, W9UZ, W2EF, W6AKW, W6CDY-W6CPX, W6AYC, W6BRO, W6WN, W6BMW, W6CMQ.



The broadcast of the Army-Navy game last year was enjoyed by hundreds of thousands of fans all over the country.

Phillips Carlin broadcasting at one of the big football games.

The Big Game Comes Over--BETTER--CLEARER

MILLIONS of enthusiastic football fans are listening this fall to the play by play broadcasts of America's greatest games. They are experiencing almost as keen enjoyment as if they were sitting in the stands. The voice of the announcer comes to them clearly and distinctly because their receiving sets are Aluminum equipped.

Leading radio manufacturers are using Aluminum extensively for shielding, for condenser blades and frames, for chasses, sub-panels, front panels and for many other parts—because Aluminum so ideally meets the varied conditions that radio design presents.

It combines remarkable shielding properties, high electrical conductivity, great strength and extreme lightness.

Examine the set you contemplate buying. If it is Aluminum equipped you may rest assured that the manufacturer has done everything in his power to give you the finest possible reception.

And if you are building a receiving set use Aluminum for finest results.

We will gladly send you the booklet, "Aluminum For Radio," which explains the varied radio uses to which Aluminum is adapted.

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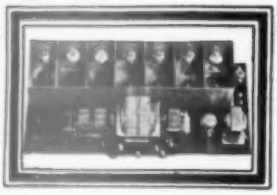

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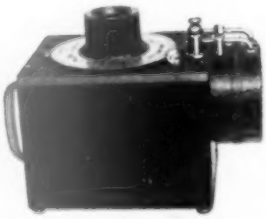

Type 108-S

10-20-40-80 Meter Bands. Each band covers the whole dial and we don't mean perhaps!

Don't Check Out January 1st.

The type 108-S is the solution to your frequency-measuring problem. The low price of $21 is an introductory offer. Orders will be filled in rotation. Order yours now and save delay.

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3335 33d Avenue, South Seattle, Wash.

STATEMENT OF THE OWNERSHIP, MANAGEMENT, CIRCULATION, ETC., REQUIRED BY THE ACT OF CONGRESS OF AUGUST 24, 1912.

Of *QST*, published monthly at Hartford, Conn., for October 1, 1928.

State of Connecticut } ss:
County of Hartford }

Before me, a Notary Public in and for the State and county aforesaid, personally appeared K. B. Warner, who, having been duly sworn according to law, deposes and says that he is the business manager of *QST* and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management (and if a daily paper, the circulation), etc., of the aforesaid publication for the date shown in the above caption, required by the Act of August 24, 1912, embodied in section 411, Postal Laws and Regulations, printed on the reverse of this form, to wit:

1. That the names and addresses of the publisher, editor, managing editor, and business managers are: Publisher, The American Radio Relay League, Inc., Hartford, Conn.; Editor, Kenneth B. Warner, Hartford, Conn.; Managing Editor, F. Cheyney Beekly, Hartford, Conn.; Business Manager, Kenneth B. Warner, Hartford, Conn.

2. That the owners are: (Give names and addresses of the individual owners, or if a corporation, give its name and the names and addresses of stockholders owning or holding 1 per cent. or more of the total amount of stock) The American Radio Relay League, Inc., an association without capital stock, incorporated under the laws of the State of Connecticut. President, Hiram Percy Maxim, Hartford, Conn.; Vice-President, Chas H. Stewart, St. David's, Pa.; Treasurer, A. A. Hebert, Hartford, Conn.; Communications Manager, F. E. Handy, Hartford, Conn.; Secretary, K. B. Warner, Hartford, Conn.

3. That the known bondholders, mortgagees, and other security holders owning or holding 1 per cent. or more of total amount of bonds, mortgages, or other securities are: (If there are none, so state.) None.

4. That the two paragraphs next above, giving the names of the owners, stockholders, and security holders, if any, contain not only the list of stockholders and security holders as they appear on the books of the company but also, in cases where the stockholder or security holder appears upon the books of the company as trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting, is given; also that the said two paragraphs contain statements, embracing affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and securities in a capacity other than that of a bona fide owner; and this affiant has no reason to believe that any other person, association or corporation has any interest direct, or indirect in the said stock, bonds, or other securities than as so stated by him.

5. That the average number of copies of each issue of this publication, sold or distributed, through the mails or otherwise, to paid subscribers during the six months preceding the date shown above is ..... (This information is required from daily publications only.)

K. B. WARNER.

Sworn to and subscribed before me this 22d day of September, 1928.

Caroline S. Crisman,

(My commission expires February, 1931.)

Calls Heard

(Continued from Page 54)

Sgt. Henry P. Karr, Hq. Btry., 2nd F. A. Bn., Camp at Gatun, C. Z.

(20 meters)

1aba 1afb 1aga 1afd 1ajd 1akm 1alb 1alm 1amp 1apv 1asf 1asu 1aw 1axp 1axq 1bat 1bdq 1be 1bfs 1big 1bkv 1bma 1bqd 1bs 1bux 1age 1ca 1cax 1cd 1cdi 1cjh 1ckp 1cmp 1cpl 1da 1de 1du 1dws 1dy 1ex 1fl 1gd 1hv 1ic 1io 1jc 1lm 1my 1mr 1nw 1pd 1qh 1qo 1rd 1ry 1sw 1ssz ut 1vc 1vk 1vo 1vg 1vw 1wl

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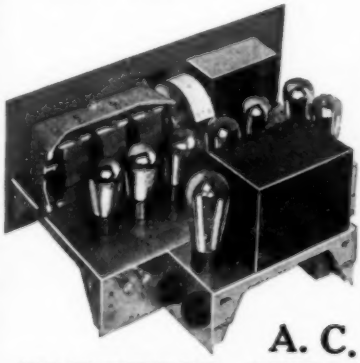

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VARIO-DENSER

Has variable capacity, adjustable from 1.8 to 20 micro-microfarads, which is .0000018 to .00002 microfarads.
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New Western Electric, Navy Transmitting and Receiving Set, 10 watt, 1 Receiver & Transmitter C. W. 1055, 1 SC No. T 1 Breast plate microphone, 1-1 A Helmet with 194 W. headphones, 1 Westinghouse Dynamotor 12-350 volts D. C., 1 CW 1057 Seaplane Interphone control box and necessary cables with plug connectors. Set is equipped with 3 VT1 tubes and 1 CW 1059 Ballast lamp, outfit for $75.00. Largest stock of Government Radio Transmitting and Receiving material in U. S. Send 2c stamp for our new and latest reduced price list. Ship anywhere. WEIL'S CURIOSITY SHOP, 20 South 2nd St., Philadelphia, Pa.

1wu 1xf 1xae 1zz 2ag 2aga 2agn 2aic 2ail 2aio 2ang 2anp 2api 2ar 2avz 2ays 2aza 2azu 2bac 2bal 2be 2bg 2bha 2bjr 2bke 2bm 2br 2bvg 2bx 2cgu 2byw 2chk 2ckw 2cx 2fm 2ff 2gp 2jj 2jy 2kx 2md 2mp 2nn 2od 2ow 2pj 2rb 2rs 2rz 2sh 2tp 2uj 2va 2vi 2wl 2xad 2xam 2yi 3ac 3adm 3ads 3aic 3aajh 3aarc 3bgg 3cj 3cv 3ec 3ez 3gr 3jj 3jm 3ke 3mv 3nz 3on 3qv 3wn 3za 4aba 4ncz 4adb 4aer 4am 4apj 4bl 4ea 4ek 4fe 4jr 4rm 4ok 4pd 4st 4uo 5abi 5acl 5aeq 5aot 5ats 5bf 5by 5cl 5gm 5jw 5kg 5pt 5we 5yd 6ago 6ah 6aiz 6ajm 6alw 6ana 6ann 6avl 6avp 6azr 6azs 6bc 6btx 6bvx 6bxf 6cfj 6csj 6cve 6cxi 6czq 6dcv 6dhq 6dj 6dlo 6dom 6dud 6jn 6ph 6ps 6pw 6rj 6sh 6sk 6xi 6yq 6zde 6zzo 7abg 7ago 7awf 7ccl 7dd 7fe 7fn 7fs 7mn 7mr 7vu 8adm 8agy 8ajn 8ane 8arj 8ava 8avb 8avx 8awf 8axa 8baz 8bbl 8bbp 8ben 8bfw 8bhz 8bk 8bov 8bqf 8brh 8bz 8caj 8cer 8ced 8cft 8cfr 8clc 8clp 8clt 8cmb 8cnj 8cpb 8cpq 8cpx 8cug 8cvq 8cyg 8ddn 8dc 8dds 8dey 8dpk 8dpo 8drj 8dsp 8dsy 8dtp 8ex 8ez 8fd 8gz 8jj 8mq 8nq 8oq 8rd 8re 8ul 8xf 9aas 9afa 9akz 9alz 9ant 9anz 9aod 9aqi 9as 9aur 9auv 9avv 9asl 9bc 8bca 9bcd 9bhb 9bhp 9bjk 9blu 9bkm 9bkz 9bm 9bmw 9bov 9bpx 9bqv 9bqy 9btw 9byo 9cfm 9cmv 9crd 9dbc 9dbm 9dcw 9dkq 9dmb 9dng 9dpb 9dpk 9dps 9dqy 9eap 9ecl 9ef 9egb 9ehn 9ein 9emb 9etk 9ewp 9ez 9fq 9gl 9hl 9hn 9inz 9mc 9nv 9oj 9sq 9ax 9sv 9vi eb-4au eb-4cb eb-4ra ed-7jo ed-8zg ee-ear62 ef-8fb ef-8fd ef-8fr ef-8orm eg-2bm eg-2nh eg-5by eg-5hs eg-5ma eg-5ml eg-5uw eg-5yq eg-6jk eg-6rb ef-6sa eg-6td eg-6yq ej-7dd nc-3cs nc-3rg nc-4nv nc-4rn nc-6by np-4apf oa-2fm oa-2no oa-5cm oh-6alm oz-4am sa-6avl sb-1aw sb-1ib.

(40 meters)

1aao 1ah 1aiu 1ap 1axx 1bda 1bea 1bkp 1bux 1ca 1cd 1chg 1fd 1gw 1im 1lp om 1ow 1rp 1xa 2abe 2agf 2alp 2apd 2atk 2azy 2bav 2bdh 2bt 2cty 2cub 2da 2do 2dx 2gu 2nf 2ng 2ov 2vc 2xaf 3aba 3aed 3alq 3ani 3bnu 3bqz 3cfg 3cpg 3fg 3na 3nd 3lw 3tc 4aar 4acv 4acz 4ap 4caa 4co 4cw 4dq 4ei 4ng 4nu 4oo 4pt 4qa 4si 4tk 4tu 4wd 4zx 5ac 5afx 5ahx 5aqe 5aut 5ave 5axi 5ayq 5bj 5bx 5ef 5ek 5ql 5rv 5ut 5vx 5wj 6aah 6ac 6avv 6bcc 6bih 6bmw 6bng 6dap 6dl 6dmh 6dmp 6eb 6em 6qb 6ya 7akq 7bd 7bx 8agv 8agy 8agz 8akx 8aul 8baz 8bc 8bm 8brf 2cbf 8cdb 8cq 8dne 8do 8dqb 8eq 8nf 8ru 9aip 9ama 9aok 9api 9ay 9baf 9bam 9bir 9bjz 9cld 9cy 9des 9dp 9du 9ehn 9ud 9ux ea-wy eb-4cb eb-4cc eb-4ft ee-ear28 ef-8dmf ef-8gr ef-8grg ef-8vvd eg-5cb eg-5ma eg-5ml eg-5uw eg-5yk ei-1fp ei-1gn ek-4vf eu-rdw nc-2ea nc-4cs nn-1nic nq-2cf nq-7cx oa-2rx oa-5mb oa-5ox sb-1ah sb-1ao sb-1bq sb-1ca sb-1ic sb-1id sb-2ad sc-2as su-1na.

(80 meters)

1aaw 1abz 1ad 1aef 1afb 1ait 1ahv 1alb 1anh 1apl 1asd 1asu 1avk 1awk 1bbj 1bep 1bfz 1bi 1bjp 1bqd 1bvl 1cat 1ebt 1ccw 1cdb 1cfp 1cmd 1cra 1di 1dr 1fl 1hb 1hp 1il 1in 1ku 1mk 1pe 1pi 1qb 1sl 1vb 1wq 1xv 1yb 2aat 2abi 2ad 2afj 2aid 2aif 2aig 2aiz 2alo 2aoo 2aww 2ayg 2bcp 2bek 2bex 2bfd 2bfi 2bfp 2bgm 2bhl 2bic 2bif 2bsc 2cbp 2cep 2cp 2cpd 2cpg 2ctm 2cvf 2evh 2exl 2ezr 2dv 2ec 2ev 2gp 2gw 2gx 2jx 2mt 2sc 2se 2ab 2wz 2xg 3abi 3ac 3aade 3aadm 3aei 3ael 3afw 3agi 3ahe 3akp 3ale 3aob 3aqi 3aqh 3asc 3awu 3bgs 3bit 3blp 3bmh 3bns 3bar 3bst 3bwt 3ca 3cee 3cfg 3cjw 3dew 3jh 3qp 3ux 3xs 3zf 3zi 3zs 4aau 4acd 4af 4bl 4cn 4cs 4ff 4fx 4gl 4ie 4lu 4qy 4rn 4sp 4wc 4wg 4xe 5aqd 5qa 6aod 6don 8aag 8acq 8acx 8ae 8ais 8ajk 8akc 8ako 8ald 8alu 8amu 8apb 8arx 8asc 8atq 8atr 8avk 8ayb 8ayu 8bcm 8bcq 8bcs 8bfn 8bgd 8bja 8bnr 8bti 8bts 8byn 8cfi 8chc 8chy 8cjb 8cmw 8cng 8cns 8crf 8cyc 8dbm 8dbu 8ded 8dcq 8ded 8dkx 8dme 8dok 8doq 8ds 8ey 8jb 8kr 8mm 8pt 9aaf 9anj 9ahk 9ain 9amu 9apg 9apy 9atv 9baw 9bcc 9bdt 9bhc 9bhs 9bwj 9bwn 9cmv 9cpr 9crm 9crv 9cuo 9dae 9dba 9dds 9des 9dgw 9ebo 9edo 9egq 9ejt 9ekw 9eqi 9esn 9hh 9ox.

W7JC-W7ZZC, 434 Clark Ave., Billings, Montana

(40-meter band)

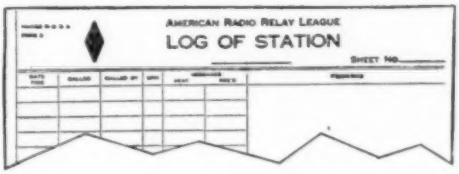
xem-sfv fe-8jcx fm-8az fm-8as na-7to nj-2pa nm-1g nn-1nic no-5fl nz-fr5 oa-2aw oa-2cs oa2gw oa-2hc oa-2hm oa-2kb oa-2kj oa-2me oa-2ns oa-2rb oa-2rc oa-2rf oa-2rz oa-2sh oa-2xi oa-2yi oa3bm oa-3bq oa-3dc oa-3jk oa-3jw oa-3ls oa-3me oa-3ml oa3wh oa-2wm oa-3yx oa-4ab oa-4cm oa-4lj oa-4nw oa-5pn oa-4wa oa-5by oa-5hg oa-5mb oa-7dx oa-7lj oc-8xz oc-6qh oh-6dws oo-1aj oz-2aw oz-2ba oz-2bg oz-2bh oz-4xc sc-2ab.

(20-meter band)

eg-5sw oa-2uk oa-2wf oa-2xr k6dqn.

EVERY TRANSMITTING AMATEUR USES THESE FORMS

—a reminder that your supply may be low—



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Designed by hams for hams. 8½ x 11 bond paper, punched for standard three-ring loose-leaf binder. 125 sheets postpaid for $1.00 or 500 for $3.50.

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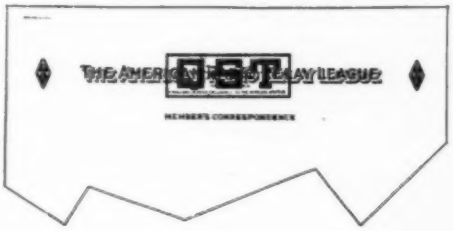

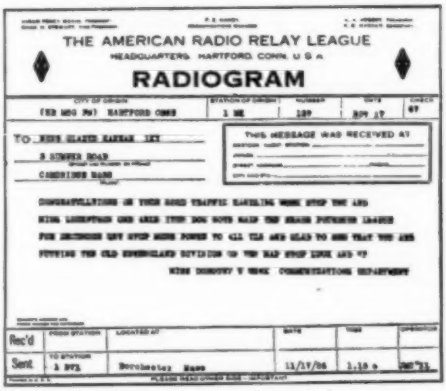

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Most convenient form. Designed by the Communications Department of the A.R.R.L. Well printed on good bond paper. Size 8½ x 7¼. Put up in pads of 100 sheets. One pad postpaid for 35c or three pads for $1.00.

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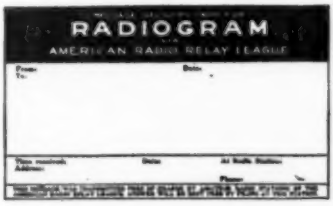
Neatest, simplest way to deliver a message to a near-by town. On U.S. stamped postals 2c each. On plain cards (for Canada, etc.) 1c each postpaid.



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1711 Park Street **Hartford, Conn.**

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Just like having an expert operator in your home.

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Expert Radio Operator Travel. Adventure. Good pay.

This amazing instrument teaches you to read code like an expert in half the usual time. Reproduces actual sending of expert operators. Sends you messages, radiograms, etc. at any speed. Provides practice anywhere, anytime. Complete instructions recorded on strong, waxed-tape records make everything simple and clear. You'll be amazed when you hear it send. Just like having an expert operator in your home. Why delay when you can get this simple, practical and efficient code sender with lessons for only $3.50; or with high-frequency key and buzzer for $5.50. Satisfaction guaranteed. Money back if not delighted. Send to-day.

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W4GP 1025 Fairmount Ave., Anniston, Alabama

w6adk w6aie w6aim w6ajh w6ami w6aov w6apd w6arv w6ase w6asj w6awy w6bcq w6bi w6bir w6bmo w6bp w6sb w6bxi w6byz w6cah w6ccw w6cee w6cdb w6cdl w6cdv w6cj w6cri w6ctd w6cuk w6cxd w6czt w6dbo w6dev w6dfr w6dfs w6dgq w6dhe w6dhs w6dlx w6dnm w6dpf w6dpu w6dwj w6dzl w6dzs w6fa w6io w6oe w6tj w6tn w6ty w6va w6wc w6xbb w6zan w7aeu w7ajh w7alk w7if w7rj w7sg w7ui w7wb w7wi nj-2pa nm-lg nm-9a nn-cab nn-7nic nq-2ay nq-2iq np-2jt nq-5fc nq-5fl nr-2ea nt-2fp nz-fr5 oa-2kj sa-4ao oa-4ra oa-5hg oa-5ht k6alm op-1om oz-1aj sb-1ay sb-1aw se-1em se-2ea.

Correspondence Department

(*Continued from Page 73*)

A Ghost of the Past

Glen Avenue,
Arlington, P. O.,
Baltimore, Md.

Editor, *QST:*

Last night I happened across an odd file that used to repose on the shelf in the radio shack that nestled under the "old back porch". My thoughts ran back to those hectic days of "nineteen sixteen" when the non-sync spark crashed its "merry" way over the receptive ether.

Perhaps, a few of the "Old Timers" will get a real thrill over something that I found in the box. The "find" bears the stamp of old 3RD at Bancroft Park, Baltimore, Maryland; and the following is self-explanatory.

PRESIDENTIAL RELAY, 1916

. . . . For the first time in the history of this grand Republic, the amateurs will demonstrate to the public that they can be relied upon to help the Goverment. We all feel highly honored to be given the chance by President Wilson to demonstrate how well we can pass around this country a message from the white house. . . .

PURPOSE OF THE RELAY

First, to get you interested in perfecting your station. Secondly, as the air will be perectly quiet on the night of this relay, you will have a chance to check up on your receiving outfit. Thirdly, to get a number of good receiving stations that can hear NAA and NAJ, at all times. This list will be turned over to the Government authorities. Fourthly, to satisfy the curiosity of the President of the United States as to our real worth, and assist the Department of Commerce, all of whom have rendered the amateurs valuable assistance. Fifthly, to give prizes to the most successful amateurs.

The message will start from station 9XE, in Davenport, Iowa, and will be relayed through the following stations, on the night

It IS Good!

38,500 Copies of the

Radio Amateur's Handbook

Are Referred to Daily for Guidance and Information

Order Now

We believe that The Radio Amateur's Handbook, by F. E. Handy, Communications Manager, A.R.R.L. is the most valuable book which any amateur or experimenter could own. Its chapter headings will give an idea of the thoroughness with which the subject is covered. They are "What Is An Amateur?" "Getting Started", "Fundamentals", "How Radio Signals Are Sent and Received", "Building a Station—The Receiver", "The Transmitter", "Power Supply, Keying and Interference Elimination", "Antennas", "The Wavemeter—Radio Measurements", "The A.R.R.L. Communications Department", "Operating a Station", "The Experimenter".

These chapters each occupy from ten to forty pages—indicating that each subject is treated in a thorough manner. In addition there is an appendix containing a fund of useful data. Then there is an index, occupying six pages, by which the valuable information contained in the book is made available. This in a particularly important point and has been compiled and cross-indexed with great care and thought. Altogether the Book contains 256 pages of the most valuable radio information ever found between two covers.

The Radio Amateur's Handbook starts at the beginning and tells what an amateur is, what the League is, what amateur radio is, how to become an amateur, how to learn the code, how to understand what you hear, how to get your licenses, how to build a simple station, how to build a better station, how to operate your station, how the A.R.R.L. works, how to handle traffic, how to conduct experiments and make measurements, and a multitude of other things too numerous to mention.

Anyone who is at all interested in the technical side of radio can ill afford to be without The Radio Amateur's Handbook.

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HARTFORD, CONN.
Dear Sirs:

Enclosed find my $..... Please send me postpaid (any where in the world) my..... copy of the Handbook.

Name .....

Address .....

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Short Wave Converter Unit

Complete

$22.50

Special

Some of the best entertainment of the air is broadcast on the short waves by many powerful stations. There is no longer any reason why all should not receive these excellent programs from all over the world. The Dresner Short Wave Converter Unit is completely assembled. It efficiently covers a wave band of 15 to 550 meters, and makes reception easily obtainable for all. Offered at the special price of $22.50—*complete ready to plug into your receiver in a few seconds.* If your dealer cannot supply you SEND MONEY ORDER DIRECT and we will ship P.P. prepaid. GUARANTEED. (When ordering unit, be sure to specify whether it is to be used on AC or DC set.)

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Become an EXPERT RADIO OPERATOR

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75-100 meters	17.50
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Sections of any practicable dimensions made to order.

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"Ten years crystallographic experience"

of the 27th of October at 10:00 P.M., Central Time. . . . . Starting from 9XE on low power, the message will be relayed automatically by Dr. Hall's famous Recording Relay at station 9XR.

INSTRUCTIONS

Keep yourself quiet until sending stations have finished. Then, by previous arrangements, which you must make, relay this message to all parts of your state. You have until the night of the general election to land this message anywhere, but don't forget the mistakes. . . .

PRIZES

To the amateur, school, wireless club, or association that delivers the message to Mr. Hughs and gets his recipt for it, we will give a 1-Kw. Thordarson transformer.

To the one getting the greatest number of signatures from citizens of the United States, attached to a copy of the message, so that they must read it, we will give a Tubular Audion Panel, mounted and ready for use.

Changed Times

1229 Chandler Avenue
Evansville, Ind.

Editor, *QST:*

Until recently, I considered the dusting of cobwebs from a ham transmitter a huge joke. I have, however, gone through that experience and find it one of the essentials in staging a comeback.

A sorrowful surprise unexpectedly awaited me. Upon getting on the air, I found not the old-time pleasure I once collected from the heap. The conversations seemed mechanical and without the zest of personal feeling. The operators all seem to be rookies instead of the good, steady operators of the past.

I began speculating as to the cause of these conditions. Is it possible that it is only I that feel so because I am not as well acquainted on the air as I formerly was? Could it be that short waves have shortened our vocabularies when on the air? Have these waves impaired our operating and caused it to be carried on in this nervous manner? Has the spirit of amateur comradeship and coöperation, that medium which made amateur radio, been lost in this maze of high frequency and lower power?

If, in the course of time, this letter should take up space in *QST*, the real amateur's testament, perhaps some amateurs who feel as I do on the subject, would endorse my remarks and present their views.

—Charles A. Luigs, 9EBW.

Rotten Fists

336 Burns Street
Forest Hills,
Long Island, N. Y.

Editor, *QST:*

1BFX hits a very important point in his letter headed "Help" on page 70 of the July issue.

VITROHM Transmitting Grid Leaks and Rheostats now cover the entire line of transmitting tube circuits. ¶The prices on these amateur products are reduced materially. ¶Your dealer should stock Vitrohm Transmitting Products. ¶If you have difficulty in obtaining them, write us direct.

CATALOGUE NUMBER	PRODUCT	RESISTANCE	DISSIPATION	CURRENT	MAX. TUBE RATING	PRICE
507-2	Grid Leak*	5000 ohms	44 watts	90 m.a.	100 watts	$2.00
507-3	Grid Leak*	5000 ohms	200 watts	200 m.a.	1000 watts	2.80
507-4	Grid Leak†	50,000 ohms	200 watts	60 m.a.	1000 watts	6.50
507-5	Grid Leak†	20,000 ohms	200 watts	100 m.a.	1000 watts	4.25
507-51	Grid Leak*	10,000 ohms	200 watts	135 m.a.	1000 watts	4.00
507-66	Grid Leak**	15,000 ohms	200 watts	120 m.a.	1000 watts	6.00
507-63	Rheostat†*	50 ohms	50 watts	1 amp.		5.50
507-59	Rheostat*†	20 ohms	80 watts	2 amp.		5.50
507-83	Rheostat*†	12.5 ohms	60 watts	2.2 amp.		5.50

* Center-tapped
† DeForest P or R. C. A. 852 Tube
De Forest H Tube

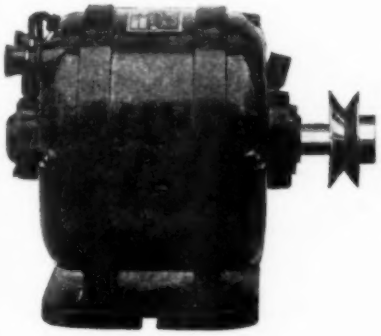
** Steps at 5M—10M—15M for R. C. A. 852 or DeForest P Tube
†* For Primary Control
*† Filament and Primary Control

Ward Leonard Electric Company

37-41 South Street - Mount Vernon, N. Y.

Synchronous Motors for Television

In addition to building reliable and satisfactory motor generators, "Esco" has had many years of experience in building *electric motors* for a great variety of applications.



Synchronous motors, small, compact, reliable, self starting are now offered for ***Television*** equipment. They require no direct current for excitation, are quiet running and fully guaranteed.

Other types of motors suitable for Television may also be supplied.

Write us about your requirements.

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225 South St. — *Trade* "ESCO" *Mark* — Stamford, Conn

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One of the Most successful Developments of 1928

Power Amplifiers Built Around U X 250 Tubes

The following are Approved Dongan Parts for use with UX 250 Tubes.

7568—Transformer for full wave rectification using 2-UX281 tubes to supply B and C power to receiver and power for 2UX 250 Tubes. $13.50

8529—Transformer similar to 7568 with the addition of 2 low voltage windings, one for 226 tubes and the other for 227 tubes so that you can build a power amplifier for either radio receiver or phonograph pick-up. $16.50

6551—Double Choke, for use with above transformers $15.00

D-600—Power Amplifier Condenser Unit ..$16.50

D-307—A Condenser Block used in connection with D-600 .....$10.00

1177—Straight Power Amplifier Output Transformer. $12.00

1176—Same as 1177 but of Push Pull type $12.00

Custom Set Builders can secure any of these items direct from factory at trade discounts. Set Manufacturers are offered the full cooperation of Dongan Engineering department for their individual requirements.

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It is true that fellows do not try to work some of the new gang. I have cut, myself, at times, and so would any man with any respect for the rest of humanity. I do not mind QSZ, and will repeat as often as a chap wishes. I don't mind sending at eight or ten per but I sure can't stand having good Continental murdered the way some of these boys are murdering it today. They are not all newcomers, either. Possibly the chap who can rarely get QSO has such a rotten style or QSC that very few can read him. I tell them and then they get mad, so the only thing to do is to QRT.

Personally, I will not answer a sloppy CQ or call and if others felt the same way, things would sound better on the air. Even the commercial operators are getting sloppy of late and I think it is due to ham influence. Could we not have some incentive supplied by the League which would promote better, cleaner operating? Honest, it's awful.

—A. Adair Leonard, "ld at ex 1AYZ—1ACB—1XAK—WPA—KNU—KFZQ.

Alpha Lambda Chi

108 Homer Avenue
Buffalo, N. Y.

Editor, *QST:*

Much has been said and written concerning the nuisance of long continued CQs but with apparently little effect in correcting this evil. There seems to be a well-established conviction among many hams that in order to be successful in establishing QSO it is necessary to send a long CQ. I have counted as many as sixty. It is evident that I could have answered after the first three. *QST* suggests nine, which ought to be adequate. It is my opinion that long CQs are only answered to get the nuisance off the air.

At the recent Atlantic Division Convention, I observed great activity in initiating delegates into various "Greek letter fraternities". As far as I could ascertain, the chief activity of these societies is the initiation. Now, why not add one more and make it a universal one. Call it the Alpha Lambda Chi (meaning "Against Long Calls") and hold an initiation at each convention, the qualifications being only two, viz., (1) Promise not to send long CQs, (2) Promise not to answer long CQs.

I believe that if more of us would ignore long CQs, the practice would soon become obsolete.

—Burton C. Simpson, 8CPC.

G B A

117 North Sixth Street
La Crosse, Wisc.

Editor, *QST:*

As a suggestion as to why so many of the QSL cards sent out never receive a reply to the sender in the form of a re-

JEWELL

Still the Standard

Pattern No. 64
Radio Frequency
Ammeter

Jewell thermo couple ammeters for high frequency work are still the standard of the amateur fraternity for making current measurements at radio frequency, for they completely fulfill the requirements of accuracy, low loss and high overload.

The thermo couples of these ammeters, which are available in various ranges, are made from special electric furnace alloys of non-oxidizing nature. A guaranteed overload capacity of 50% is an indication of their ruggedness. The loss in the instrument is held to less than one half of the minimum required by the Navy.

The Pattern No. 64 high frequency ammeter has a three inch, black enameled case. Scales are silvered with black characters and movement parts are silver plated. All Jewell instruments have zero adjusters.

Jewell radio frequency ammeters are described and listed in Radio Instrument Catalog No. 15-C. Write for a copy.

Jewell Electrical Instrument Co.

1650 Walnut St., Chicago, Ill.

"28 YEARS MAKING GOOD INSTRUMENTS"

New Transmitting Tubes

We expect to have available in a short time the most complete line of transmitting tubes ever sold in this country. Output ratings from 5 to 1000 watts, with prices far below tubes now offered. Particularly adapted to short wave use. If interested, send your name for full details when ready to release.

Quartz Crystals, guaranteed. 160 meter band, $10.00; 80 meters $17.50; 40 meters $25.00.

Public Address Equipment

Starting with our well known and widely used **Two Button Broadcast Type Microphone** at only $40.00, we can supply any equipment for public address work and similar uses. T3020 Microphone Transformer, $10.00. "Trumpet" Horns, as used in Public Address Equipment, complete with unit, $25.00.

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Splitdorf Electric Co.
Magnavox Corporation
Electrical Research Lab's.
Samson Electric Co.
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Tell us about the resistor you want. If we can't supply you from our standard range of sizes, we shall be glad to make up samples for you with prices. Write to

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215 Emmet St.
Newark, N. J.

Television Simplified

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Quickly puts 25 per Hams in 35-40 per class. Five Hams report made this gain in few evenings. One of them by 75 minutes total practice only.

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New Hook-ups. This book shows how to make Short Wave Receivers and Short Wave Adapters. How to use the new screen grid tube in D. C. and A. C. Circuits. How to build Power Amplifiers, and ABC Eliminators. Up to the minute information on all new radio developments. Set Builders, Fans, Dealers, send for it today.

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turn card, will say that I still get cards reporting my signals and addressed to calls which I have not had for several years.

If the gang would spend four bits for a new call book, they would save that much in lost cards and postage.

Very truly yours,

—Edwin L. Benton.

Information

Montrose, Iowa.

Editor, *QST:*

For some time you have been telling about the help the beginner is getting from the old timer. They should, no doubt, receive this assistance but there is one phase of the subject that has not been given enough attention.

Since you published my report on 20-meter work in the April issue of *QST*, I have been getting letters from beginners asking all sorts of questions.

First of all, most of them imagine there is some big "hocus pocus Indian Medicine Man" stuff that we say to a set to make the wave do its stuff. The only time that I ever said anything was when a tube blew.

In the second place, they don't even tell you what they want to know. Several have said that they had built low power transmitters that didn't work the way they should and, "What's the matter?" How can any answer be made to that question? If they don't ask any specific questions, they should, at least, enclose a complete diagram of the set giving constants.

Last, but not least, a whole lot of them sealed the letter and forgot to enclose a two cent stamp. To be sure, they ran after the postman but couldn't catch him. In most stations, correspondence is a big item of expense and if we must pay postage as part of the accommodation of answering questions, there will be fewer tubes bought. The questioner should bear his share of it.

To work 20-meters or any other wave, the chief things necessary are a steady note and a good radiating system. This is old stuff. *QST* has been preaching it for years, but it seems that lots of fellows have missed it or else, were in such a hurry while reading it that they don't know what its all about.

Please don't take it from this that I don't like to help a beginner. I sure do. However, I don't want to answer fool questions like, "Can I work so-and-so on 20-meters with my set?" And then, tell me nothing about the set. Neither will I pay the postage or read their minds!

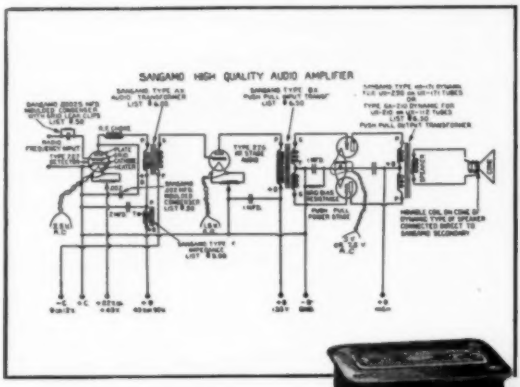
—Bob Heine, 9AWB

This applies to a still greater extent in the handling of the Information Service at Headquarters.—*A.T.E.*

Build this modern amplifier at low cost!

Now! Sangamo Transformers at a new low price. *And push-pull transformers to match new power tubes and dynamic loud speakers.*

A small expenditure and you can have one of these modern amplifiers with plenty of capacity to handle the low notes. Nothing equals the full toned beauty of an amplifier built according to the diagram shown at right.



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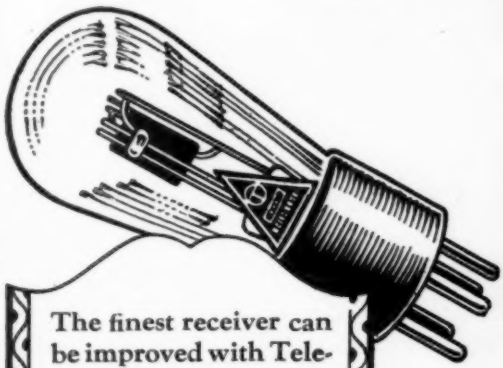

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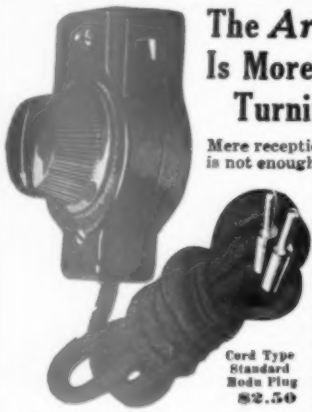

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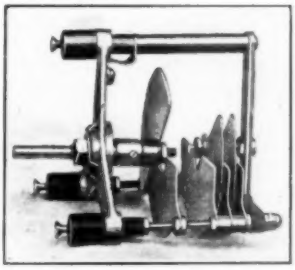
A New Condenser

THE amateur will have to keep on his toes if he is to keep up with the fast-growing crop of new equipment which is appearing on the market to meet his needs in the new year. Changed frequency bands, more limited territory and the consequent need for a higher standard of performance is to result in the production of much new apparatus designed to fulfill the more stringent requirements. Falling in this category, the new variable condensers of the Radio Engineering Laboratories are worthy of study.

Departing from normal practice the condensers are fitted with a rugged die cast "Y" shaped end plate in which is mounted the double conical bearing. An unusual



and commendable feature of this bearing is that the shaft runs in a pool of mercury and so is free from the electrically noisy contact which has been such a bug-bear in tuning elements.

Several types of condenser are provided, each with this end plate assembly as a foundation. In one of these, which is fitted with a single stator and single rotor plate, the capacity range is made adjustable by provision for the movement longitudinally of the stator plate. In a second type the capacity range can be varied by adjustment of a lumped adjustable capacity built into the condenser.

In all of the models the plates are of heavy brass, the construction, in general, being splendidly substantial.

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PLATE BLOCKING AND GRID CONDENSERS
For 2000 V DC
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For 1500 V. D. C.

A More Effective and Dependable Condenser FOR LESS MONEY

That's the unanimous opinion of "hams" everywhere. They stood up for W2APD —the amateur who handled traffic from storm-swept and devastated PORTO RICO. (W2APD was personally commended for his excellent work by the U.S. Navy) and, there are W2ALU and W2KR, the amateur stations that are handling a large amount of the traffic from the BYRD EXPEDITION—WFBT. OF COURSE, THESE FELLOWS USE FLECHTHEIM! YOU, TOO, SHOULD USE THEM.

(sig) 73's W2afs, Chief Engineer

Write for New Catalog X

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Also by removing the input and output transformers it can be used as a source of power for an oscillating or transmitting tube, furnishing power for all circuits, grid, plate and filament and is the cheapest form of Power Supply for Amateur Transmitting purposes ever offered. New.

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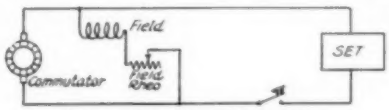
TRANSMITTING HINTS

WHY NOT SERIES GENERATORS

MR. William O'Neill of Downers Grove, Ill., suggests that plate supply generators would give a better output from the tube transmitter standpoint if built so that at least a part of the field winding was in series with the armature so that it could act as a filter choke. Since the ordinary shunt generator has no series winding at all but is connected as shown in Fig. 1 it is necessary to use a freakish circuit to take advantage of

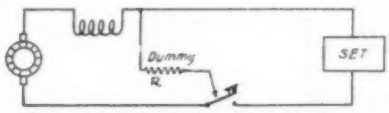


Ordinary Shunt Wound Generator
FIG 1

the idea. In Fig. 2 the field has been put in series with the load and as this would mean that there is no field whenever the load is off an extra load R has been connected in parallel with the regular load. When the key is up and the load disconnected this extra load provides enough current so the machine voltage does not disappear. The trouble with these schemes is of course that the machine voltage

Changed to Series
FIG. 2

changes when the load goes off and on. Therefore the final arrangement is that of Fig. 3 in which the key connects the load R to the circuit whenever the set is not



Changed to Series with a dummy load on back contact of key
FIG. 3

connected. The load R should of course draw about the same current as the set. The scheme was tried on a ½-kilowatt 1000-volt Western Elec. machine running at 2250 r.p.m. This machine had a slot ripple of 712 cycles and a weak commutator ripple of 3562 cycles. When connected as shown the ripple was almost completely removed with no filter but a 1 microfarad condenser.

The real way out would appear to be to design machines compound instead of shunt when they are to be used for telegraphing which is a service quite different from broadcast work.

15 Mmf. Max.
25 Mmf. Max.
50 Mmf. Max.
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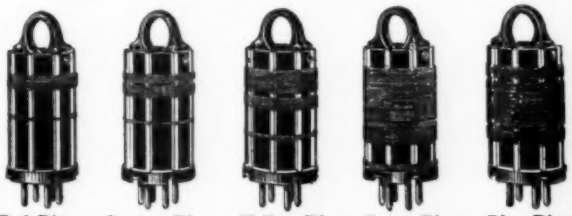

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Eby A.C. Adapter Harness with Volume Control. For 6 tube Sets, list $10.00	"	5.00 "
Gould Kathanode Unipower, Automatic Radio "A" Power (6 volt), list $39.50	"	13.75 "

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The above prices are for grinding a crystal at a random frequency, said crystal to be of the FOWER type, and its frequency will be stated accurate to better than a tenth of 1%. All crystals are absolutely guaranteed, and immediate deliveries. Add $10.00 to the above prices if crystal is to be mounted in our POWER type of Holder.

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We desire to announce that we can make prompt delivery on crystals ground to your assigned frequency accurate to PLUS OR MINUS 500 CYCLES for $45.00 Unmounted or $55.00 Mounted. In ordering please mention plate voltage and type of tube used. These crystals are absolutely guaranteed.

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THE USEFUL MAZDA LAMP

Mr. F. A. Lidbury of Niagara Falls contributes an idea that most of us should have thought of but did not. It is given herewith.

"Though the idea is an obvious one, I have never seen a note on the usefulness of the ordinary incandescent lamp as a protective resistance in the plate supply of transmitting tubes. In adjusting my 50-watt power amplifier recently, I found a bank of these things invaluable. I have 8-125 volt, 50-watt Mazdas mounted in series on a strip of hard rubber in my 1000-volt plate supply. On a short circuit or its equivalent these limit the current to 400 m.a.; on the other hand, with a normal drain of 100 m.a. the voltage drop over the bank of Mazdas is only about 60; and this 6% loss is low pay for the protection obtained. Of course a short circuiting switch, after adjustment, will get rid of this loss, but I prefer to take it myself on account of the protection obtained should anything unexpected happen in the course of operation. It is not generally realized type would be better for this purpose on when lightly loaded. If it were, I am certain that this very simple device would be more used. Below are tabulated some *very rough* measurements of the present common form of 50 watt lamp. Column 1 gives the current in milliamperes; column 2 the voltage drop per lamp, and column 3 the voltage drop over the bank of eight lamps described above. This will be sufficient I think, to give an indication of what they will do. The lamps in question are, I believe, gas filled, and the older evacuated type would be bettter for this purpose on account of the possibility of internal arcing over in case of a filament breakage; but I didn't happen to have any handy at the time, and one usually has to order them specially now. I don't think there would be any essential difference in the use, though the resistance curves are probably different somewhat.

Mazda Type A 50 Watt 125 Volt

CURRENT IN M. A.	VOLTS PER LAMP	VOLT DROP OF 8 LAMPS IN SERIES
50	1.4	11
100	8	64
150	19	152
200	33	264
250	51	408
300	74	592
350	100	800
400	125	1000

I am sending this to you because I found it is useful myself; of course smaller and fewer lamps would be used for a 210, larger and more (or higher voltage lamps) for a 204. I daresay this has been suggested time and time again; but I haven't happened to see it, and I daresay a lot of other fellows haven't. I am told that the vacuum type is what is sold as "rough service". I believe these were actually the ones referred to above."